VOL. XLI JANUARY 1957 NO. 1

THE JOURNAL OF AGRICULTURE
of the
UNIVERSITY OF PUERTO RICO

1903

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PUBLISHED BY
UNIVERSITY OF PUERTO RICO
AGRICULTURAL EXPERIMENT STATION
RIO PIEDRAS, P. R.

Entered as second-class matter June 1, 1953, at the post office at Rio Piedras, under the Act of August 24 1912, as amended by the Act of August 4, 1947.

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THE JOURNAL OF AGRICULTURE
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Issued quarterly by the Agricultural Experiment Station of the University of Puerto Rico, for the publication of articles by members of its personnel, or others, dealing with any of the more technical aspects of scientific agriculture in Puerto Rico or the Caribbean Area.

Vol. XLI January 1957 No. 1

A Comparison of Different Leaf-Sampling Techniques Used in the Foliar Diagnosis of Sugarcane in Different Countries

G. Samuels, S. Alers Alers, and P. Landrau, Jr.[1]

INTRODUCTION

Foliar diagnosis is being used in many sugarcane-producing areas of the world as a means of determining the fertilizer needs of the cane. However, the same techniques are not used by all workers in foliar diagnosis. Differences exist in methods of sampling and interpretation of data.

Halais (*4*)[2] in Mauritius utilizes a leaf-punch sampling technique on the whole third leaf of the cane for nitrogen, phosphorus, and potassium analyses. He prefers sampling the cane at from 5 to 7 months of age, using ratoon but not plant canes. Sampling is not advised by this worker unless rainfall exceeds 2 to 3 inches during the preceding fortnight, winds do not exceed 30 to 40 miles per hour, and there is no great damage by pests and diseases.

In Hawaii, the system of crop-logging devised by Clements (*1*) is used commercially. The system makes use of periodic sampling throughout the life of the crop to control fertilizer applications, irrigation, and cane-ripening. Leaf blades Nos. 3, 4, 5, and 6, with their corresponding leaf sheaths are collected. The leaf blade is used for determining nitrogen and the sheath for phosphorus, potassium, moisture, and total sugars.

Innes in Jamaica (*5*) makes use of the lamina of the third fully opened leaf for nitrogen, phosphorus, and potassium analyses. The fertilizer recommendations are based on field experimentation and complementary advisory procedures are based upon the leaf analyses.

In British Guiana, Evans (*3*) utilizes the first cane leaf from the top with a visible dewlap. This top visible-dewlap leaf is used for nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron, copper, zinc, boron, and molybdenum determinations.

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[2] Italic numbers in parentheses refer to Literature Cited pp. 9–10.

In Puerto Rico cane-leaf blades Nos. 4, 5, and 6 are utilized for nitrogen, phosphorus, and potassium analyses, and the corresponding leaf sheaths for moisture determination (*7*). The midrib is not removed from the leaf blade before analyses.

The different methods of sampling for foliar diagnosis in sugarcane, plus the differences in manner of reporting the results, have made comparisons of results between various cane-growing areas in the world somewhat difficult. To evaluate these differences for the sake of comparisons, foliar-diagnosis samples of sugarcane were procured by using the procedures adopted by each of the workers mentioned. The results obtained, as evaluated and standardized, are presented in this paper.

PROCEDURES INVESTIGATED

The foliar-diagnosis procedures used for comparison were those of Halais in Mauritius, Clements in Hawaii, Evans in British Guiana, and Samuels, *et al.*, in Puerto Rico. These methods were selected primarily because they are already in semicommercial or commercial practice, and adequate literature is available giving both procedures and standard indexes of nutrient levels. There are, of course, other workers using foliar diagnosis for sugarcane, and also other procedures. But, at present, these unreported workers are new to the field, and very few data are available; or they are following present methods only slightly or not at all modified; or their new procedures are still too undeveloped to be applied on a commercial scale.

First of all, the numbering of the sugarcane leaves and sheaths must be clarified. Such vague indications as, "The first leaf from the top", etc., have caused much confusion. Van Dillewijn (*8*), one of the leading authorities on sugarcane morphology, favors the system of Kuijper for designating the various organs of the cane plant. Basically this system designates the highest visible dewlap as +1, the leaf to which this dewlap belongs as leaf +1, and the sheath and joint on which the leaf is implanted the same. Leaf +1 represents the topmost of the unfolded leaves, any leaves younger than this, or still folded, are consecutively numbered 0, −1, −2, etc. The older leaves are consecutively numbered +2, +3, etc. This order is shown in figure 1.

Unfortunately, no such standard system is used throughout the world where sugarcane is grown. Each foliar-diagnosis system has evolved its own particular rules for cane-leaf numbering, and leaf No. 1 for one system is not necessarily the same as leaf No. 1 for another. It would be a very good idea if some sort of standard leaf-numbering could be adopted. However, for the practical purposes of this article, the leaf number used by the procedure being discussed will be given, followed immediately, in parentheses, by the Kuijper number as shown in figure 1.

The various leaf-sampling methods used are summarized in table 1, and more complete descriptions are as follows:

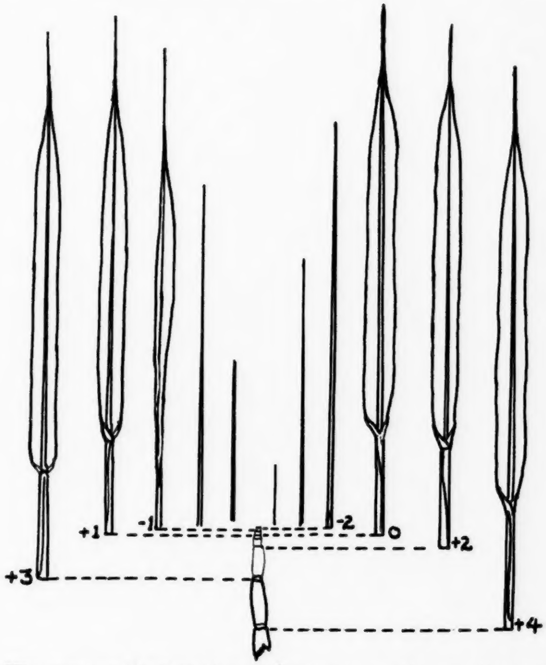

FIG. 1.—The cane top showing the various leaves used in sampling. The leaves are numbered in accordance with the system of Kuijper; after Clements (*8*).

MAURITIUS (*4*)

The leaf-rank rule is to tear off the whole blade of the third leaf (+1) starting from the top, the one partly unfolded counting as the first leaf (−1). The number of leaves constituting a sample should not fall below 60 when regularly spread over the field. The extremities of the collected leaves are removed, keeping just 6 inches of the central portion. The midrib is removed and the laminae are piled one over the other. A leaf-punch is made with a borer fashioned from an empty copper cartridge. The collected punches are placed in a sampling box. Chemical analyses are made of the dry leaf tissue for nitrogen, phosphorus, and potassium.

TABLE 1.—*A summary of leaf-sampling procedures for the foliar diagnosis of sugarcane used in different countries*

Country	Age when sampled	Leaf blades[1]			Leaf sheaths		
		Regular No.	Kuijper No.	Analyzed for—	Regular No.	Kuijper No.	Analyzed for—
	Months						
British Guiana	4½–5	(2)	+1	N, P, K, micro-elements	(3)	(3)	(3)
Hawaii	3–24	3, 4, 5, 6	+1, +2, +3, +4	N	3, 4, 5, 6	+1, +2, +3, +4	P, K, Ca, Mg, moisture, total sugar
Jamaica	4–5	3	+1 or +2	N, P, K	(3)	(3)	(3)
Mauritius	5–7	3	+1 or +2	N, P, K	(3)	(3)	(3)
Puerto Rico	3	4, 5, 6	+2, +3, +4	N, P, K	4, 5, 6	+2, +3, +4	Moisture

[1] Including midrib for all countries except Puerto Rico.

[2] Top dewlap.

[3] Not utilized.

HAWAII (*1*)

Five canes are selected from representative sites in the field. Leaves Nos. 3(+1), 4(+2), 5(+3), and 6(+4), are selected. The middle portion of the leaf blade is used, after removal of the midrib, for nitrogen determination. The corresponding leaf sheaths, when dried and ground, are used for the determination of phosphorus, potassium, moisture, and total sugars.

BRITISH GUIANA (*3*)

From 30 to 50 leaves showing the highest visible dewlap (+1) are used. The middle 8 inches of these leaf blades is separated into chlorophyllous tissue and midrib, the latter being discarded. The fresh tissue is dried rapidly at 80°C. in a forced-draft oven, ground, and stored in airtight bottles until analyzed for nitrogen, phosphorus, and potassium, and certain microelements.

PUERTO RICO (*7*)

Depending upon many factors, a sample consists of five or more canes. Leaf blades Nos. 4(+2), 5(+3), and 6(+4), counting the partly unrolled spindle leaf as No. 1(−1), are removed, together with their corresponding leaf sheaths. The leaf sheaths, severed from the leaf blades at the collar joint or ligule, are placed in special moistureproof bags for use in moisture determinations. The leaf blades are cut into 2- or 3-inch sections with a section taken from the basal, middle, and tip section of the leaf blade. This leaf-blade material containing both laminae and midrib is dried, ground, and analyzed for nitrogen, phosphorus, and potassium.

OTHER TECHNIQUES

Innes, in Jamaica (*5*), utilizes the whole third leaf as used in Mauritius. Du Toit (*2*), in South Africa, takes the whole third leaf blade, including the midrib. Lunin and Aughtry in Santo Domingo (*6*) employ the crop-log technique of Clements.

PROCEDURES AS USED

The methods of foliar diagnosis used in British Guiana, Hawaii, Mauritius, and Puerto Rico were utilized in sampling 10 fields of sugarcane varying from 3 to 5 months in age. The varieties sampled were B. 37161, P.R. 980, M. 336, and P.O.J. 2878. In all cases 10 canes were selected at random for each sampling procedure. The number of leaves and parts utilized for chemical analysis in each method were selected according to the stated procedure of each system. A special study was conducted for determining the variation in nutrient value of various leaves. Three separate fields of plant cane of P.R. 980 and M. 336 were used at a cane age of 3 months. Ten cane samples were utilized for each leaf.

RESULTS

The comparison of the various sampling methods is given in table 2. From a field standpoint, no appreciable difference was encountered in leaf numbers when the British Guiana method of using the first visible dewlap was compared with the Mauritius method of using the whole third leaf. Therefore, the British Guiana method is given in the work reported in table 2, although similar values were obtained with the Mauritius method.

Very little difference existed in nutrient content of the leaf blades when using the Hawaiian or British Guiana methods, although the British Guiana values were slightly higher than those derived by the Hawaiian system. The leaf-blade values when using the Puerto Rican method were lower in nitrogen and phosphorus and higher in potassium than when the other two methods were used. The major difference in the Puerto Rican method is the fact that the midrib is not eliminated from the leaf blade for analysis.

TABLE 2.—*A comparison of the nutrient composition and moisture content of sugarcane leaves when using different leaf-sampling methods*

Origin of method	Nutrient content of leaf blades on a dry-weight basis for—			Nutrient content of leaf sheaths on a dry weight basis for—			Moisture content of leaf sheath, green-weight basis
	N	P	K	N	P	K	
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
British Guiana	2.22	0.23	1.79	0.69	0.08	2.02	83.1
Hawaii	2.16	.22	1.77	.75	.09	2.28	84.7
Puerto Rico	1.74	.20	1.89	.71	.08	1.92	83.6

A clearer understanding of why certain similarities and differences exist can be obtained when we examine the analysis of the various components of the cane leaf itself. A comparison of the various cane-leaf values is given in table 3. Nitrogen shows little variation in the range of cane leaves normally sampled, leaves Nos. 3(+1) to 6(+4). There is a decrease with increasing leaf number for phosphorus, potassium, and sheath moisture. Thus one would expect that the Hawaiian method, using leaves Nos. 3(+1), 4(+2), 5(+3), and 6(+4), would give somewhat lower phosphorus, potassium, and sheath-moisture values than the British Guiana or Mauritius methods, which use only leaf No. 3(+1).

A comparison of the analyses of various parts of a cane leaf blade is given in table 4. The lamina is much higher in nitrogen and phosphorus, but lower in potassium, than the midrib. Thus, for the Puerto Rican system, wherein the whole leaf blade is used, midrib included, we would expect lower nitrogen and phosphorus values and higher potash values than for the other methods which use the lamina only.

Table 5 was compiled to serve as a guide in making comparisons between the various methods of foliar diagnosis used on sugarcane in different parts of the world. The optimum values for foliar diagnosis of sugarcane as given by the leading authorities in each area were all standardized to represent leaf-blade tissue without midrib. Where midrib tissue was included in the values from Puerto Rico, these were converted by appropriate factors derived from tables 2 and 4. Appropriate factors were used to convert to leaf-blade values of the Hawaiian method where phosphorus and potassium are determined using the sheaths. All values reported are in nitrogen, phosphorus, and potassium and needed changes were made from P_2O_5 and K_2O values used in Mauritius and Jamaica.

TABLE 3.—*A comparison of the nutrient composition and moisture content of the different sugarcane leaves used for foliar diagnosis*

Leaf No.	Kuijper No.	Nutrient content of leaf blade on a dry weight basis for—[1]			Moisture content of leaf sheath
		N	P	K	
		Percent	*Percent*	*Precent*	
3	+1	1.56	0.19	1.71	84.5
4	+2	1.61	.17	1.61	83.3
5	+3	1.60	.17	1.52	83.0
6	+4	1.58	.15	1.36	82.6

[1] Midrib is included.

TABLE 4.—*A comparison of the nutrient composition of different parts of the sugarcane leaf blade*

Part of blade	Nutrient content of sample on a dry weight basis for—		
	N	P	K
	Percent	*Percent*	*Percent*
Whole	1.62	0.15	1.53
Lamina	2.09	.19	1.47
Midrib	.79	.09	1.62

It is interesting to note that the general values for optimum levels of nitrogen, phosphorus, and potassium, are quite similar, even though they represent distinctly different geographical areas, soils, climates, and cane varieties. The greatest variation seems to be in potassium values with a low of 1.1–1.2 for Jamaica and a high of 1.72–1.90 for South Africa. Phosphorus levels show surprisingly little variation for any of the countries or techniques. Nitrogen values did not show too great variation for optimum-yield levels. Mauritius and Puerto Rico had the lowest values and Jamaica the highest.

In general, it speaks well for the practice of foliar diagnosis of sugarcane, that close agreement on leaf-nutrient values are obtained regardless of differences in sampling techniques.

TABLE 5.—*A comparison of foliar-diagnosis values for sugarcane from different countries using different techniques*[1]

Country	Nutrient content of leaf blade for optimum yields on a dry-weight basis for—		
	N	P	K
British Guiana	2.0–2.1	0.21	1.20
Hawaii	2.0	.21[2]	1.75[3]
Jamaica	2.3	.25–.28	1.1–1.2
Mauritius	1.66–1.85	.20–.24	1.12–1.32
Puerto Rico	1.80[4]	.23[5]	1.56[6]
South Africa	1.93–2.18[4]	.24–.29[5]	1.72–1.90[6]
General average	2.00	0.24	1.40

[1] Based on sample age of 4 to 6 months for plant canes. The midrib is excluded in the analyses.

[2] Converted from leaf-sheath P values by use of a factor of 2.6.

[3] Converted from leaf-sheath K values by use of a factor of 0.78.

[4] Converted from leaf N values with midrib by use of a factor of 1.28.

[5] Converted from leaf P values with midrib by use of a factor of 1.25.

[6] Converted from leaf K values with midrib by use of a factor of 0.95.

SUMMARY

Several different methods of sampling sugarcane leaves for foliar diagnosis are used in as many different countries. In order to evaluate the values obtained for nitrogen, phosphorus, potassium, and moisture, four of these were used in an experiment at this Station, and the results compared. The following findings were regarded as significant:

1. The Hawaiian, British Guiana, and Mauritius sampling methods gave closely similar values.
2. The Puerto Rican method, wherein the midrib of the leaf is included, gave lower nitrogen and phosphorus values, and higher potash values.
3. The individual cane leaves from Nos. 3(+1) to 6(+4) showed no

appreciable variation in nitrogen, but a decrease in phosphorus, potassium, and sheath moisture with increasing leaf number.

4. The analysis of the various parts of the cane leaf blade showed that the lamina was higher in nitrogen and phosphorus but lower in potassium than the midrib.

5. The optimum leaf-nutrient values for the various countries and techniques were compared after appropriate adjustments were made to standardize them on a common basis. In general, the leaf values were similar regardless of country, method, or cane variety.

RESUMEN

Cuando se compararon distintas técnicas para tomar las muestras en cuanto al diagnóstico foliar de la caña de azúcar, las diferencias fueron las siguientes:

1. Los métodos que usan en Hawaii, en la Guayana Inglesa y en Mauricio para tomar las muestras indicaron valores similares.
2. El método en uso en Puerto Rico, en el cual se incluye la vena central de la hoja, dió valores más bajos para nitrógeno y fósforo, pero más altos para potasa.
3. Las hojas de caña individuales, desde el número 3(+1) a 6(+4) no demostraron variación apreciables alguna para nitrógeno, pero los valores bajaron para fósforo, potasio y humedad de la vaina, según se aumentaba el número de hojas.
4. El análisis de las distintas partes de la hoja demostraron que la lámina tiene un mayor contenido de nitrógeno y fósforo, pero menor de potasio que la vena central.
5. Los valores óptimos de los nutrimientos en las hojas fueron comparados entre varios países, después que se hicieron los ajustes requeridos para someter estos valores a una norma igual sobre una base común. En términos generales, los valores en cuanto a las hojas fueron similares, sin tener que ver en nada con el país, el método o la variedad de caña.

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The Control of Weeds in Pineapple Fields with CMU[1]

H. R. Cibes[2]

INTRODUCTION

In a study conducted in 1948 by Piñero and Bayrón (*2*)[3] it was found that the production costs of pineapple in Puerto Rico amounted to $456.84 per acre, of which 59 percent was devoted to the cultivation of pineapple fields. Hand-labor was responsible for the major part of the cultivation expenses. This is used mainly for weeding the plantations. It is a well-known fact that pineapple plants are spaced very closely in beds of two to three rows each. These beds are alternated by wide alleyways. Whereas mechanical devices can be used to cultivate the alleyways between the pineapple beds, all the weeding inside the beds must be done with hand hoes. The fact that pineapple plants are seriously affected by weed competition, and that weeds grow profusely because of favorable weather conditions in the pineapple region, it is necessary to perform many weedings during the year. This produces the previously mentioned prohibitive cultivation costs.

The most effective way of holding the weeding expense to a minimum is by the constant and systematic use of a weedicide that will control weeds both in the alleyways and between plants in the beds without injuring them. Craft and Emmanueli (*1*), seeking such a weedicide, tested eight commercial oil fractions in the field and the greenhouse. In the greenhouse only the light fraction, stove naphtha, proved to be safe for the plants. However, in the field tests all of them injured the plants. A dinitro compound, also tested by these investigators, damaged the plants without controlling the weeds.

Since these workers performed their experiments a considerable number of new herbicides have been developed. This paper reports the results obtained with CMU in the control of weeds in pineapples.

PROCEDURE

During the last part of the rainy season of 1954 two experiments were conducted on the use of CMU for controlling noxious weeds in pineapple plantings. One began in October, the other in November. They were established in two different pineapple fields of the Smooth Cayenne variety growing in a Bayamón silty clay soil at Palo Alto in the vicinity of Manatí. The first experiment consisted of the application of CMU at various concentrations to pineapple plots about a month after planting. In the second the application of CMU was made at the same concentrations 6 months after planting. Three months later a second application of CMU was made to plots in the second experiment at the previous concentrations.

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[1] Since this work was done the trade name of CMU, 3-(p-chlorophenyl)-1,1-dimethyl urea, was changed to Karmex W.

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[3] Italic numbers in parentheses refer to Literature Cited, p. 19.

The CMU was applied with a knapsack sprayer in a pre-emergence spray at rates of 0, 2, 4, and 6 pounds per acre in 100 gallons of water over all plots. This included both the pineapple beds and the alleyways. No special precautions were taken to prevent the spray solution from coming in contact with the pineapple plants.

The plots used in the first experiment consisted of two pineapple beds of three 12-foot rows each. There was a distance of about 18 inches between plants and between rows. An alleyway 4 feet wide separated the two beds in the plots. The plot size in the other experiment was the same except that the plot length was increased to 24 feet.

The weight of the weeds harvested from each experimental plot was used as the criterion for evaluating the effect of the various treatments. Weedings were made 3 months after the differential treatments were applied. No weed counts were made, but the various species growing in the plots were identified. Periodical inspections of the plants were made to determine whether any of the chemical treatments was injuring their appearance and/or growth. The various treatments in both experiments were arranged in the field according to the pair-plot design.

The first experiment was terminated about 3 months after the differential treatments were applied to the experimental plots, that is, right after the first weeding was performed. However, it was intended to carry the second one until the crop was harvested. This would have provided an opportunity to study not only the residual effect of the various CMU treatments, but also the effect, if any, of these treatments on the production and perhaps the quality of fruits. Unfortunately, this could not be accomplished because the cooperator ruined the experiment by cultivation after the first results were obtained.

RESULTS

Tables 1 and 2 present the mean weights of weeds harvested from pineapple plots in the above-described experiments.

The statistical analyses of these data clearly showed that the growth of weeds was significantly less in the CMU-treated plots at the 5- and 1-percent levels, than in the control plots in both experiments. In fact, the plots that received the CMU applications, especially those treated with the medium and high concentrations, were practically devoid of weeds, while the checks exhibited a heavy stand 3 months after the experiments began (figs. 1 and 2).

TABLE 1.—*Mean weights of weeds harvested from pineapple plots treated with CMU at different concentrations a month after planting*

Symbol	Treatments	Mean weight of weeds
		Pounds
A	2 lb. CMU per acre	2.51
B	4 lb. CMU per acre	.56
C	6 lb. CMU per acre	0
D	No treatment	11.56

Least significant difference between means of weight of weeds at:

5-percent level	4.30
1-percent level	6.18

TABLE 2.—*Mean weights of weeds harvested from pineapple plots treated with CMU at different concentrations 6 and 9 months after planting*

Symbol	Treatments	Mean weight of weeds harvested from plots treated—	
		6 months after planting	9 months after planting
		Pounds	*Pounds*
A	2 lb. CMU per acre	2.54	1.25
B	4 lb. CMU per acre	1.04	0
C	6 lb. CMU per acre	0	.25
D	No treatment	10.27	12.54

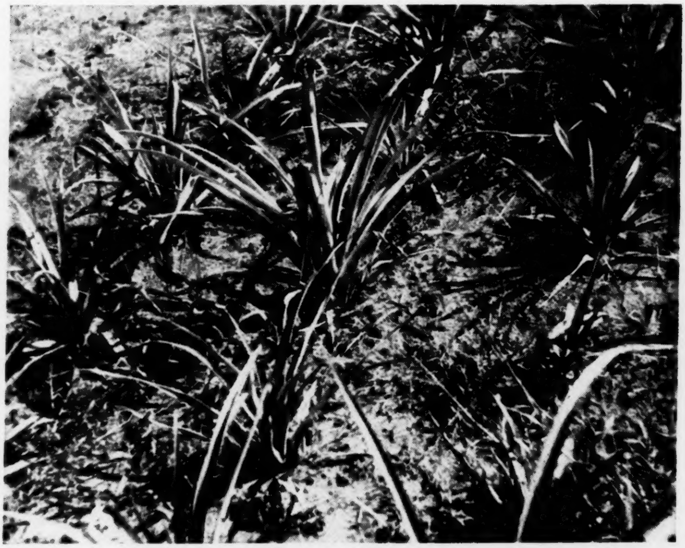
Least significant difference between means of weight of weeds from plots treated 6 months after planting:

5-percent level	2.12
1-percent level	3.04

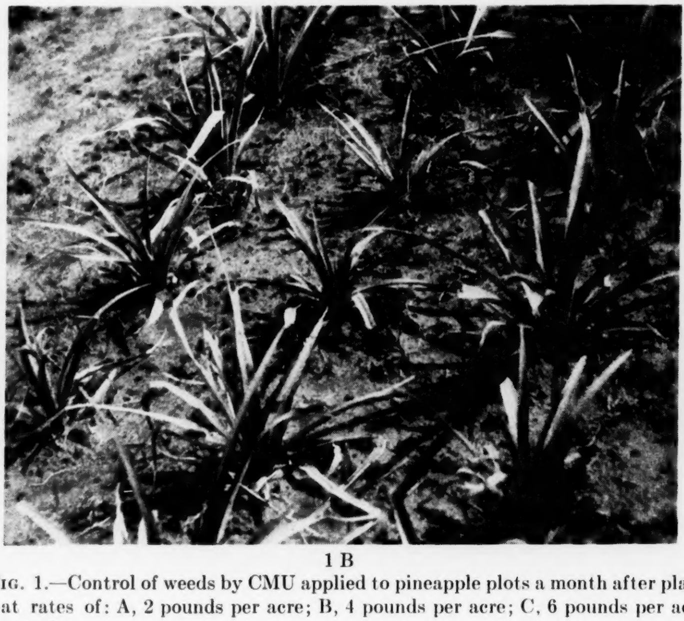
Least significant difference between means of weight of weeds from plots treated 9 months after planting:

5-percent level	5.78
1-percent level	8.00

The statistical analyses showed, moreover, that there were no significant differences between the weights of weeds harvested from plots treated with the different concentrations of CMU used in both experiments. From a practical point of view this means that, at least for a period of 3 months

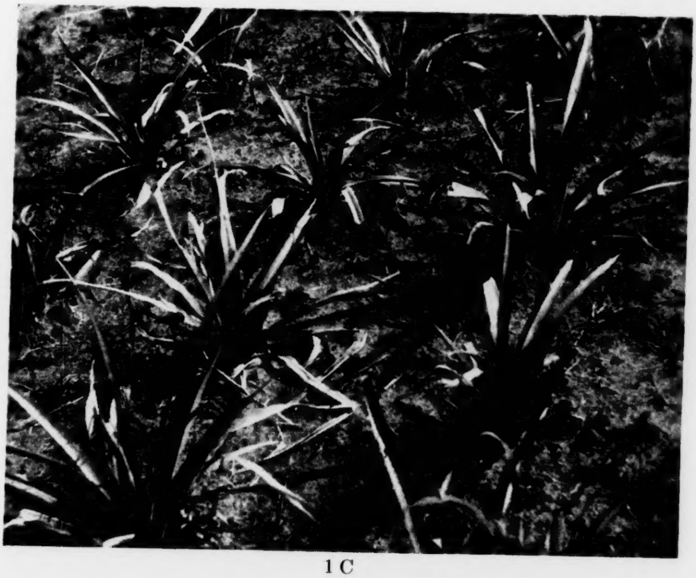


1 A



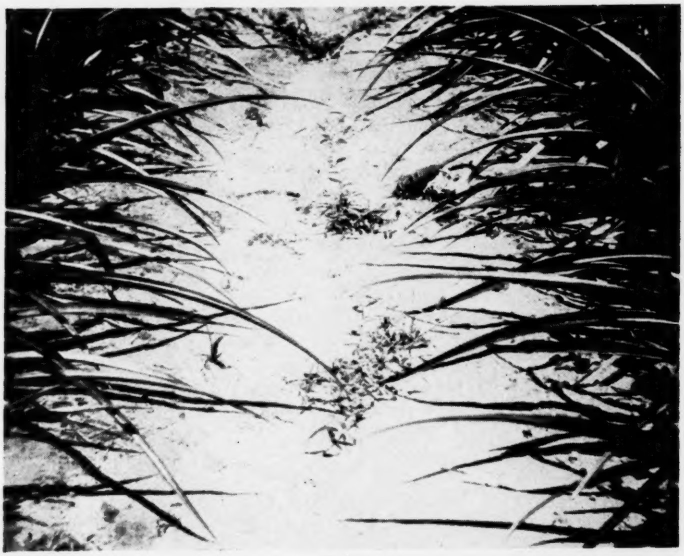
1 B

FIG. 1.—Control of weeds by CMU applied to pineapple plots a month after planting at rates of: A, 2 pounds per acre; B, 4 pounds per acre; C, 6 pounds per acre; D, control.

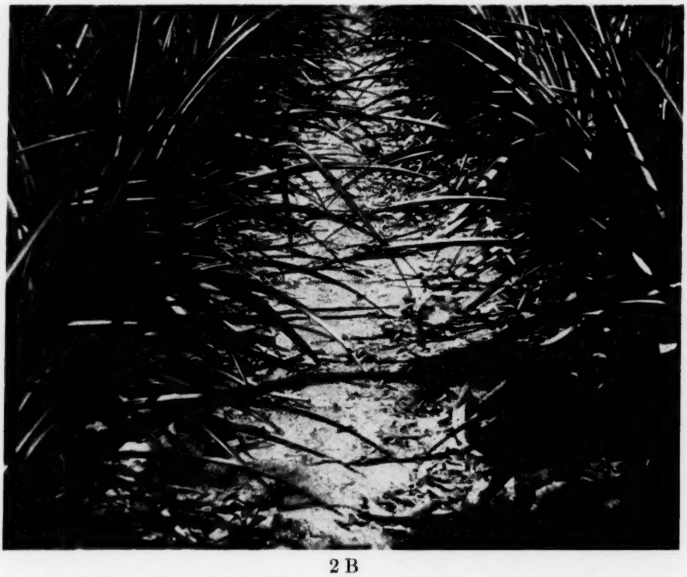


1 C

1 D

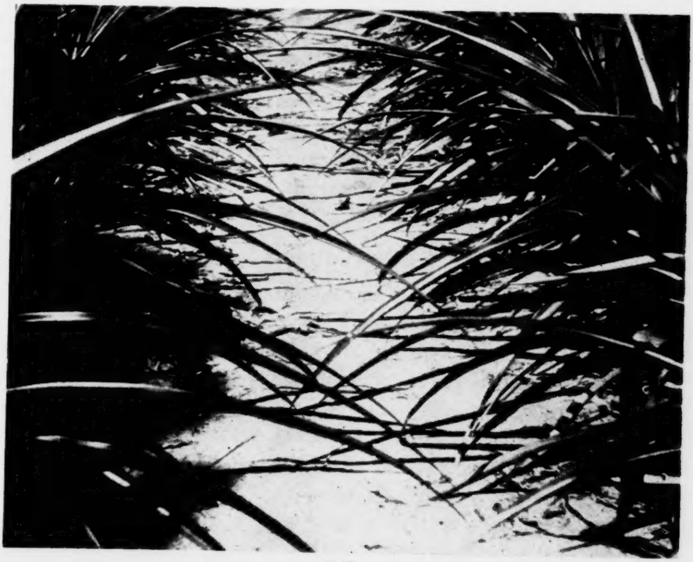


2 A

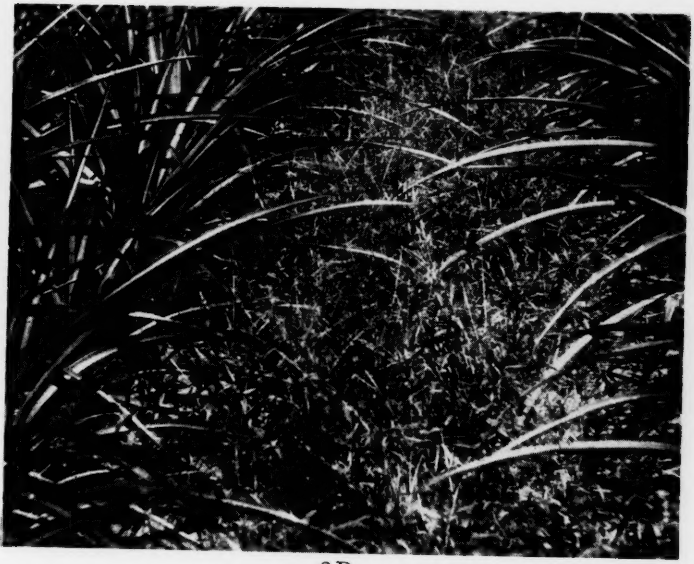


2 B

FIG. 2.—Control of weeds by CMU applied to pineapple plots 6 months after planting at rates of: A, 2 pounds per acre; B, 4 pounds per acre; C, 6 pounds per acre; D, control.



2 C



2 D

after planting, any of the CMU concentrations used would effectively control weeds in the field. However, by the end of this period there was a general tendency for the CMU-treated plots to produce fewer weeds as the concentration of the chemical was increased (tables 1 and 2). Apparently, the residual effects of CMU in this particular type of soil are related to the concentration in which it was applied. Thus, if a more lasting or prolonged control of weeds is desired, the higher concentrations are preferable.

DISCUSSION

The most abundant weed species in the control plots in both experiments were Bermuda grass (*Cynodon dactylon* L.) and pendejuelo grass (*Digitaria sanguinalis* Scop.). Pendejuelo grass was more prevalent than Bermuda grass. There were other grasses and broadleaf weeds in these plots, but very few. Bermuda grass was the only weed present in the treated plots.

As stated, the plants growing in the CMU-treated plots were examined periodically to determine whether this chemical had a detrimental effect at the concentrations and times of application used. But in no instance was any abnormal symptom noticed that could be attributed to the CMU. This was true of plants which received the chemical treatments 1 month or 6 months after planting. Not even plants which were treated for a second time with the CMU spray solution in the second experiment showed the slightest signs of injury. In other words, the pineapple plants in the CMU-treated plots, regardless of the concentrations or time of application used, looked as green and healthy as those growing in the control plots.

From the results obtained it can be concluded that CMU can be effectively used for the control of weeds in pineapple fields, at least in the northern pineapple region, for a prolonged period of time without injuring the plants.

SUMMARY

Costs of pineapple production in Puerto Rico are very high. Hand-hoeing of plantations is one of the items which contributes most to increase production expenses. Two experiments were conducted to determine the effectiveness and safeness of CMU for controlling weeds in pineapple fields economically. The results obtained were as follows:

1. Application of CMU at rates of 2, 4, and 6 pounds per acre significantly reduced the weed stand as compared to the control for a 3-month period in both experiments.
2. All CMU concentrations were equally effective in controlling weeds for about a 3-month period in both experiments.
3. No injury resulted from the application of CMU at the various con-

centrations used 1 month or 6 months after planting the pineapples. Repetition of CMU treatments to plots in the second experiment was not detrimental to the plants.

RESUMEN

Los costos para producir la piña en Puerto Rico son sumamente altos. Una de las prácticas que más contribuye a mantener los gastos de producción altos es el desyerbo a mano de las plantaciones. En 1954 se llevaron a cabo dos experimentos con el fin de determinar la eficacia y seguridad del CMU para controlar económicamente los yerbajos en las plantaciones de piña. Los resultados fueron los siguientes:

1. Las aplicaciones de CMU a razón de 0, 2, 4 y 6 libras redujeron significativamente el desarrollo de los yerbajos. Esto se comparó con los resultados en las parcelas testigos durante 3 meses en ambos experimentos.
2. Todas las concentraciones de CMU resultaron igualmente eficaces para controlar los yerbajos en ambos experimentos por un periodo de 3 meses.
3. No hubo efecto nocivo a las plantas de piña cuando se aplicó el CMU a distintas concentraciones, ni al mes, ni a los 6 meses después de la siembra. La repetición de los tratamientos de CMU a las parcelas del segundo experimento no fué perjudicial a las plantas de piña.

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A Survey for Common Tobacco- and Pepper-Mosaic Viruses in the Filler-Tobacco Area of Puerto Rico

J. Enrique Pérez, José Adsuar, and E. A. Padilla[1]

INTRODUCTION

For many years tobacco-mosaic virus has been the cause of severe losses to tobacco growers in Puerto Rico. Other viruses which are known to affect tobacco in Puerto Rico are the "mottle" mosaic (Puerto Rican pepper-mosaic virus) (*6*),[2] etch virus (*1*), and leaf-curl. In a recent publication Adsuar and López (*2*) have shown that common tobacco mosaic and "mottle" have an appreciable effect on the yield of tobacco variety Virginia 12. Since tobacco mosaic and mottle are the most prevalent and harmful virus diseases of tobacco it seemed of importance to determine by a survey of the filler-tobacco regions of the Island the extent and incidence of both mosaics, as well as the presence of any other virus, using the usual infectivity tests and serological methods. Serological methods can also be used in determining the presence of these viruses in tobacco (*3*, *5*).

OBJECTIVES

The purpose was to determine whether, by the use of both methods, a larger number of positives would be found and therefore a more complete picture of the extent of infection obtained.

THE SURVEY

The survey was carried out during a period of 3 years beginning in January 1952 and ending in April 1955. Only the Filler-Tobacco Area of Puerto Rico was included. This Area lies in the central part of the Island and includes the municipalities of Caguas, San Lorenzo, Cayey, Cidra, Aibonito, Barranquitas, Comerio, Naranjito, Orocovis, Morovis, Ciales, and Utuado. A total of 76 counties (*barrios*) were covered in these municipalities. The area surveyed is shown in figure 1.

Trips were made to the area to be surveyed two or three times a week during the tobacco-growing season for collection of tobacco samples; these were brought to the laboratory for infectivity and serological tests.

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[2] Italic numbers in parentheses refer to Literature Cited, p. 24.

EXPERIMENTAL PROCEDURE

Samples were collected as follows: Three or four leaves were collected from a plant showing symptoms of mosaic, placed in a paper bag, and the bag labeled with the number of the specimen and the name of the town and county (*barrio*) where collected. The samples were then brought to the laboratory and tested for the presence of tobacco-mosaic and pepper-mosaic viruses by the infectivity test (plant-host reactions), and also serologically by means of a precipitin test. If samples could not be tested at once they were kept in a "deep-freeze" for a few days until tests could be made.

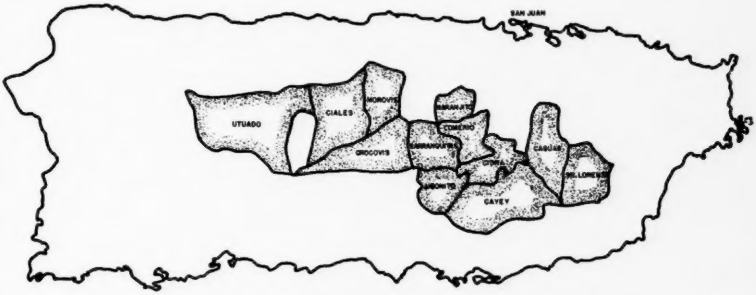

FIG. 1.—Map of the Filler-Tobacco Area of Puerto Rico.

INFECTIVITY TESTS

Samples were ground in mortars, a thoroughly washed and dried mortar being used for each sample. The ground pulp was wrung through two layers of gauze and the sap collected in a test tube. The crude sap was then centrifuged at about 3,500 r.p.m. for 20 minutes for clarification. A portion was kept for the precipitin test and another portion was inoculated to small tobacco plants having the NN factor, and also to the Large Bell Hot variety of commercial pepper (*6*). The carborundum method was used.

The appearance of necrotic spots in 1 to 3 days on the NN tobacco leaves was interpreted as indicative of infection with tobacco-mosaic virus in the sample tested. The production of systemic veinal necrosis in Large Bell Hot pepper was taken as proof of infection with the common field strain of Puerto Rican pepper-mosaic virus.

SEROLOGICAL TESTS

At the beginning of the survey several methods were tried to determine the most accurate and economical one to be employed in the serological testing of the samples. The slide-agglutination test, in which a drop of crude sap is mixed with dilute antiserum and another drop with normal serum on a slide, was tested with the first 100 samples, together with the ring test (*4*) and the technique described below. It was found that the slide-agglutination test was subject to many nonspecific reactions. Special difficulty was encountered with the more darkly colored saps in the ring test, it being almost impossible to read the reaction. Therefore, the technique described below was finally adopted as a standard for the whole series of tests.

Antisera which reacted specifically with Puerto Rican pepper-mosaic virus were prepared by injecting rabbits with a partly purified preparation of the virus. Antisera for common tobacco-mosaic virus were prepared by injecting rabbits with a purified preparation of virus isolated locally. The sera were diluted to a 1/5 or 1/10 concentration in 0.85-percent saline and about 0.25 ml. of each diluted serum placed in a 6 x 50-mm. tube with the aid of a capillary pipette. Approximately an equal volume of clarified sap was then mixed with each serum and the mixtures were incubated at 40°C. for 1 to 2 hours. Usually, 20 to 30 tobacco samples were thus tested simultaneously in a single day. The following control mixtures were always included with each series of tests: Clarified sap from each sample mixed with an equal volume of saline for control of nonspecific precipitation; tobacco-mosaic virus plus its antiserum; tobacco-mosaic antiserum plus normal tobacco sap; pepper-mosaic virus plus its antiserum; pepper-mosaic antiserum plus normal tobacco sap.

TABLE 1.—*Reaction of tobacco samples to serological and infectivity tests for tobacco-mosaic and pepper-mosaic viruses*

Total number of samples tested for—	Positive by both tests	Positive by infectivity test only	Positive by serology only	Total positives	Negative by both tests
Pepper-mosaic virus: 952	37 (3.8 percent)	32 (3.3 percent)	96 (10 percent)	165 (17.1 percent)	787 (82.6 percent)
Tobacco-mosaic virus: 906	534 (58.5 percent)	141 (15.4 percent)	14 (1.5 percent)	689 (75.4 percent)	217 (23.7 percent)

RESULTS

Nine hundred and fifty-two tobacco samples were tested by the infectivity method and serologically by means of a precipitin test for the presence of pepper-mosaic virus. Of these 952, 906 were also tested both ways for the presence of tobacco-mosaic virus. The results obtained by employing both methods of testing are shown in table 1.

DISCUSSION

The results obtained in this survey by using the usual infectivity (plant-host) method and a precipitin test for determining the presence of tobacco-mosaic and pepper-mosaic viruses in tobacco bring out several interesting facts. It may be seen that both tests are complementary rather than confirmatory. If in testing for the presence of pepper-mosaic virus, for example, the infectivity test had been used exclusively, 10 percent of the total number of positives would have been missed. On the other hand if the precipitin test had been solely employed, 3.3 percent of positive specimens would have been missed and recorded as negative. As for tobacco-mosaic virus, if only the precipitin test had been employed, 15.4 percent of positives would have escaped.

The discrepancies and lack of complete correlation between the two tests merit some discussion. In the first place one has to consider that both tests do not measure the same things, a positive infectivity test being proof of the presence of infective virus particles, while the precipitin test indicates the presence of serologically active material specific to the virus or any of its strains. It is well known that virus particles may lose their infectivity while still retaining their serological activity. Likewise the serological activity may be lost while the infectivity is retained (*3*). The serological activity of saps is correlated with the amount of virus present and the virus content of some saps may be too low to give any precipitation whatsoever.

A further comment is necessary regarding the tests for pepper-mosaic virus. Here the precipitin test gave an additional 10 percent of positives which were negative by the infectivity test. This 10 percent of positives did not give the characteristic reaction to pepper-mosaic virus on Large Bell Hot pepper described above but only mottling or even just vein clearing. This may indicate the existence of other strains of pepper mosaic which do not give the expected reaction in Large Bell Hot pepper.

SUMMARY

Results of a survey for the presence of tobacco-mosaic and pepper-mosaic viruses in the Filler-Tobacco Area of Puerto Rico, indicate that tobacco mosaic was the most prevalent, being present in a total of 75.4 percent of tobacco samples tested. Pepper-mosaic virus was found present in 17 percent of all samples tested. These results were obtained by employing both the usual infectivity (plant-host) method and precipitin tests. Complete correlation was not observed between the two kinds of tests, however and the

results show that a larger number of positives is obtained by using both tests than by using either test alone.

RESUMEN

Los resultados de un catastro llevado a cabo para determinar la presencia del virus del mosaico del tabaco y del virus del mosaico del pimiento en la zona productora de tabaco de tripa en Puerto Rico, demuestran que el virus prevaleciente es el del mosaico del tabaco. Este se encontró en un total de 75.4 por ciento de las muestras de tabaco. El virus del mosaico del pimiento se encontró en 17 por ciento de todas las muestras.

Estos resultados se obtuvieron al emplearse el método corriente de reacciones en plantas hospedadoras (pruebas de infectividad) y el método de precipitinas con antisuero. No se observó una completa correlación entre las dos clases de prueba. Los resultados muestran que se encontró un mayor número de positivos al usarse ambas pruebas que si se hubiese usado una sola. Las dos pruebas, por lo tanto, se complementan entre sí.

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Salinity Status of Lajas Valley Soils

Juan A. Bonnet and Eduardo J. Brenes[1]

INTRODUCTION

Puerto Rico, the smallest of the four islands of the Greater Antilles in the Caribbean Area, lies south of the Tropic of Cancer between 17°55′ and 18°31′ N. and between 65°39′ and 67°15′ W. In its southwestern arid area lies the Lajas Valley, that measures from 0.5 to 2 miles in width from North to South and from 20 to 22 miles in length from East to West. It is bounded by mountains on the North (fig. 1) and South.

In the Post-Glacial Quaternary epoch of the Pleistocene period, the Valley was a salty-water canal connecting the Atlantic Ocean in the West and the Caribbean Sea in the Southeast. The area was later raised by geologic forces and the Valley was filled with alluvial tuffaceous and ashy-shale detritus washed mostly from the mountains at the North. Two lagoons, one at the East and a smaller one at the West, filled the lower depressions. The run-off waters travel now into and through the long axis of the Valley; about two-thirds drains into the Caribbean Sea and about one-third into the Atlantic Ocean.

The mean annual rainfall is about 31 inches and is poorly distributed. Evaporation losses generally exceed rainfall from winter to summer. The crops suffer from drought generally throughout the year, and from excess of rainfall at some periods between summer and winter, when an excess of rainfall causes flooding or water-logging conditions owing to slow rates of discharge and percolation of the run-off waters. Brackish or salty waters for cattle use in Lajas Valley have been or are pumped by windmills (fig. 2) from several places.

A multiple-purpose project covering hydroelectric power, irrigation, (fig. 3), drainage (figs. 4 and 5), and water supply is now being constructed in that area. When finished, fresh waters will be available to irrigate about 26,000 acres in Lajas Valley.

Description of the soils and salinity problems of Lajas Valley have been discussed and published by Bonnet and Tirado Sulsona (*1*).[2]

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[1] Head and Assistant Soil Scientist, respectively, Soils Department, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R. The writers wish to express their acknowledgments to M. A. Lugo-López, Associate Soil Scientist; G. Acevedo and R. Pérez Escolar, Research Assistants in Soils, for taking the soil samples; and to G. García Monge and G. Malaret, Research Assistants in Chemistry, for their cooperation in the chemical work.

[2] Italic numbers in parentheses refer to Literature Cited, p. 34.

FIELD SURVEY AND SOIL SAMPLING

One-inch squares with sides oriented North-South and East-West, respectively, were ruled on base maps (fig. 6) on a scale of 1:10,000. The sides of each square represented roughly 835 feet and each square represented about 16 acres. Letters and numbers were used as coordinates to identify the corners of the squares. Soil samples (figs. 7 and 8) were taken with a soil auger at two depths: 0 to 8 and 8 to 24 inches, respectively, at the field locations corresponding to the corners of the squares. Every four squares, or for about every 64 acres, two more samples were also taken, at depths of 24 to 48 and 48 to 72 inches, respectively.

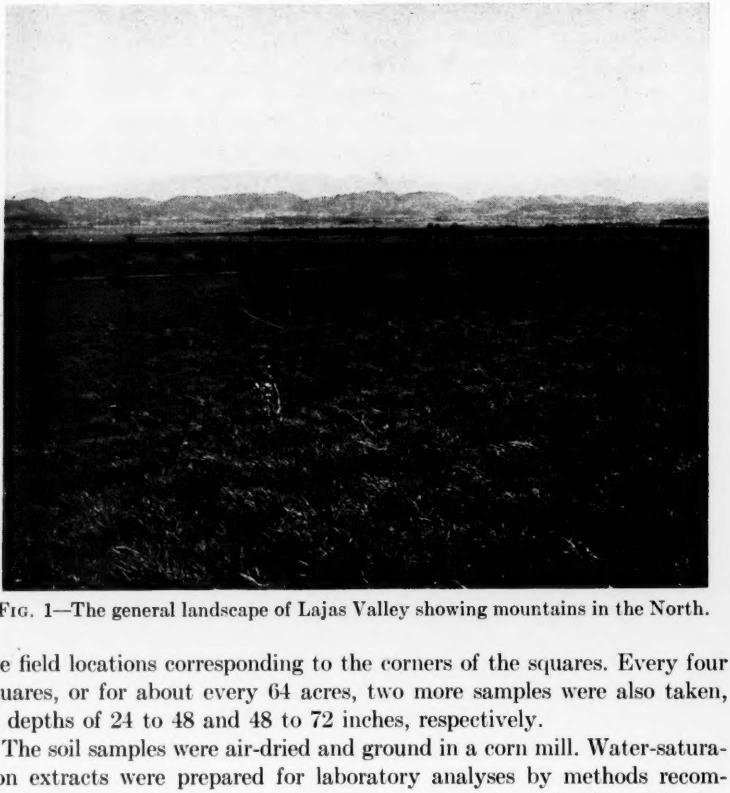

FIG. 1—The general landscape of Lajas Valley showing mountains in the North.

The soil samples were air-dried and ground in a corn mill. Water-saturation extracts were prepared for laboratory analyses by methods recommended by the U. S. Regional Salinity Laboratory (*2*). The following determinations were made: Soil pH, moisture at soil-saturation point, electrical conductivity, and calcium-magnesium soluble in the water extract. The water-soluble sodium was calculated from the laboratory data. The soluble cations were expressed in milliequivalents per liter. The exchangeable-sodium percentage was obtained from a nomogram using the data obtained, respectively, for water-extractable sodium and for water-extractable calcium-plus-magnesium.

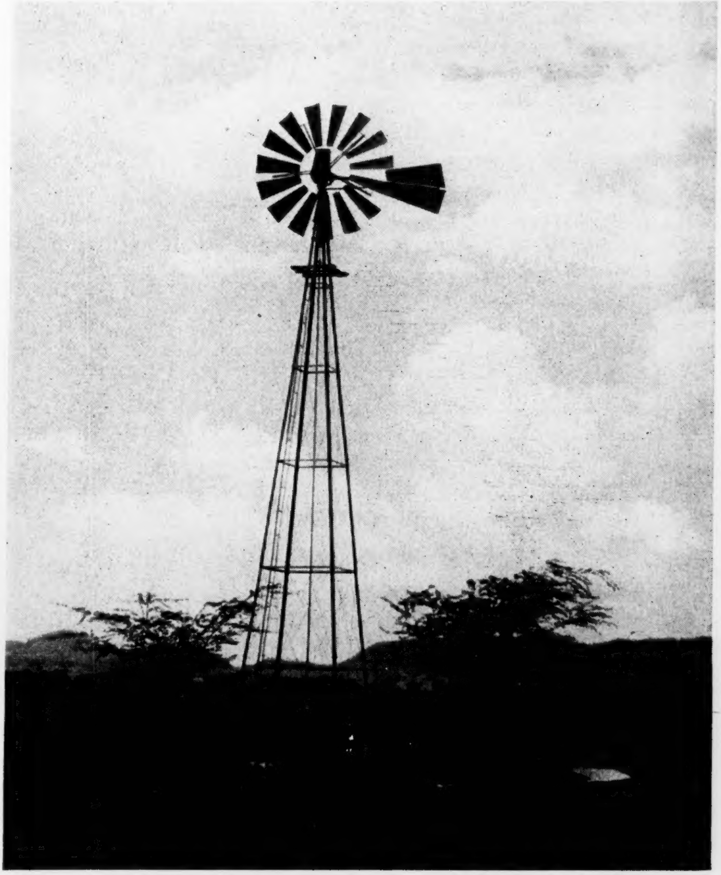

FIG. 2—Windmills are scattered around Lajas Valley farms.

The soils of the area studied were grouped into four classes: Normal, saline, saline-alkali, and nonsaline-alkali, based on the ranges for the values of electrical conductivity, exchangeable-sodium percentage, and soil pH given in table 1.

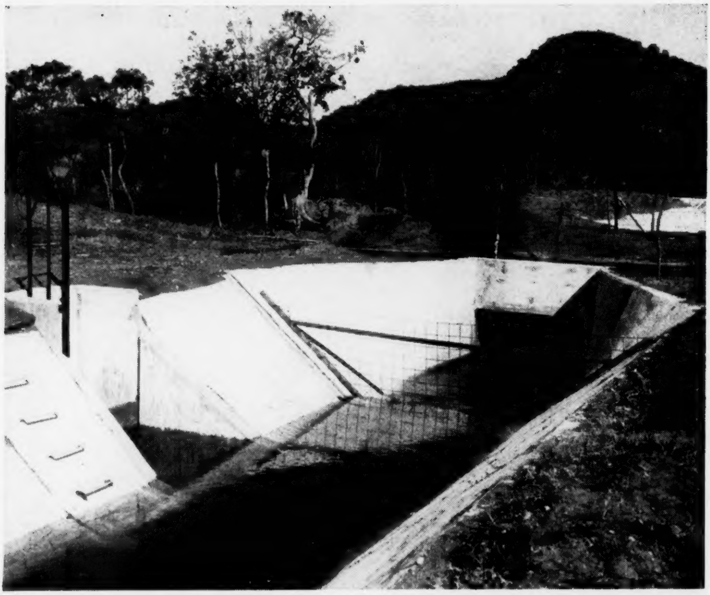

FIG. 3—Part of main northern irrigation canal with gate at the side; Lajas Valley.

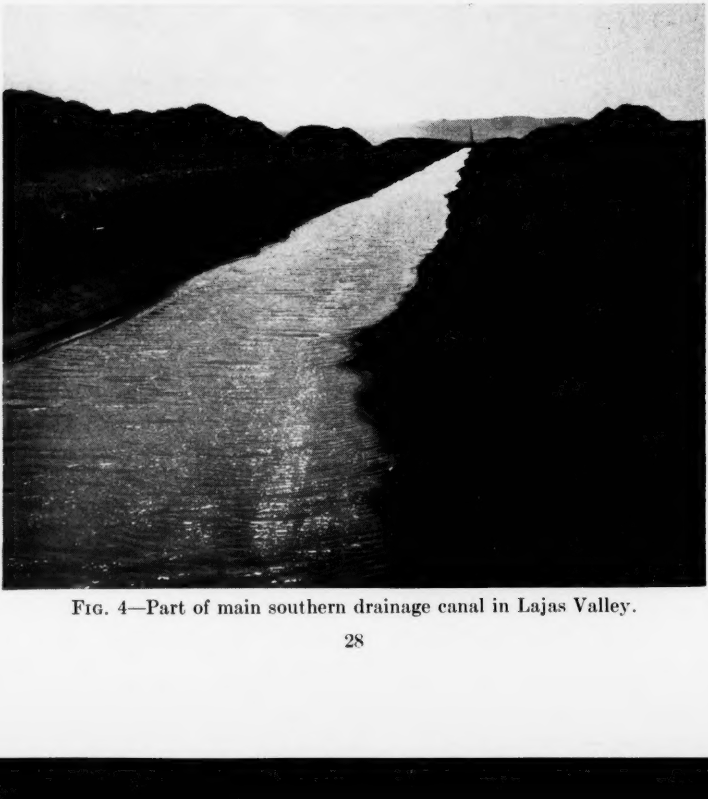

FIG. 4—Part of main southern drainage canal in Lajas Valley.

PRESENTATION OF DATA

A total of 1,541 locations representing about 24,656 acres[3] of the area were sampled at depths of 0 to 8 and 8 to 24 inches, respectively. This area included 439 locations sampled also at depths of 24 to 48 and 48 to 72 inches, respectively.

The percentages of normal, saline, saline-alkali, and nonsaline-alkali soils, per depth of sampling, are reported in table 2.

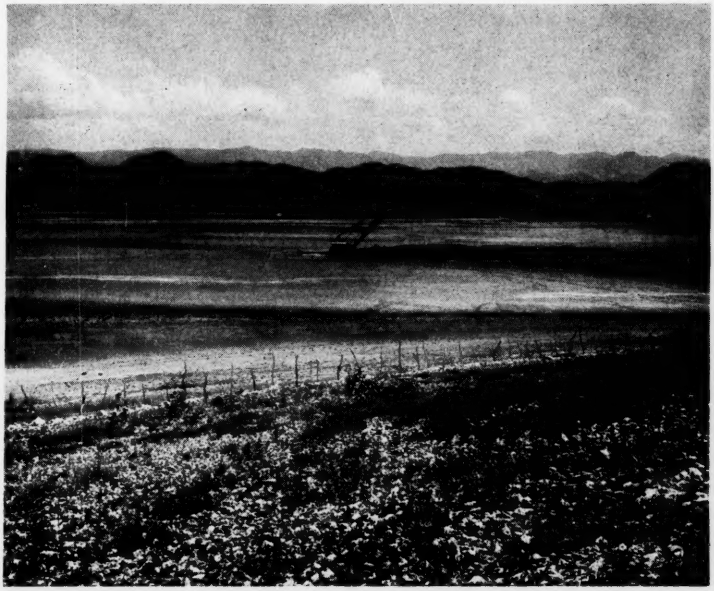

FIG. 5—Mechanical shovel digging drainage canal for drying the Guánica lagoon at the eastern part of Lajas Valley to carry excess run-off waters.

The values for saturation percentage (SP), electrical conductivity (EC), exchangeable-sodium percentage (ESP), soil pH, gypsum content, gypsum requirement, and hydraulic conducivity (K), are given in table 3 for various layers of four soil profiles of the Lajas Valley. The hydraulic conductivity was determined in undisturbed soil samples taken with a 4-inch cylindrical core. The soil layers (table 3) are also classified into normal, saline-alkali, and nonsaline-alkali soils.

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[3] A report for 11,230 acres was submitted to the Sixth International Congress of Soil Science, held in Paris Aug. 29 to Sept. 8, 1956.

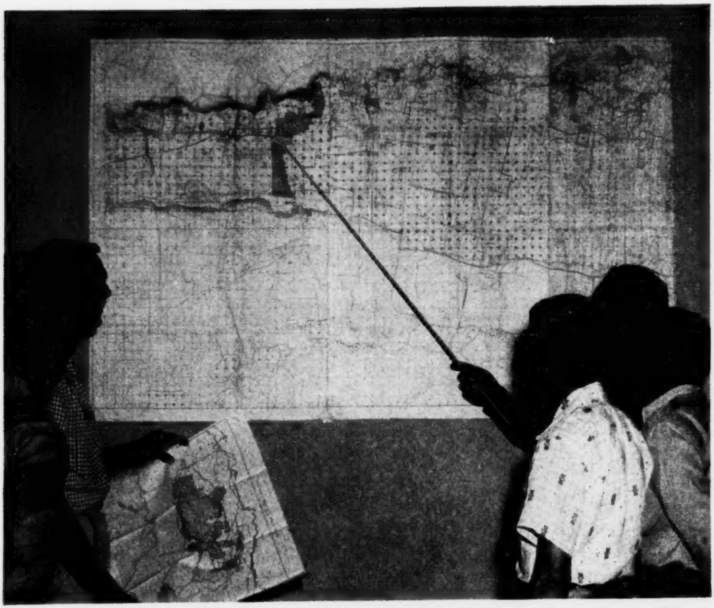

FIG. 6—Examining map of Lajas Valley showing locations for soil sampling.

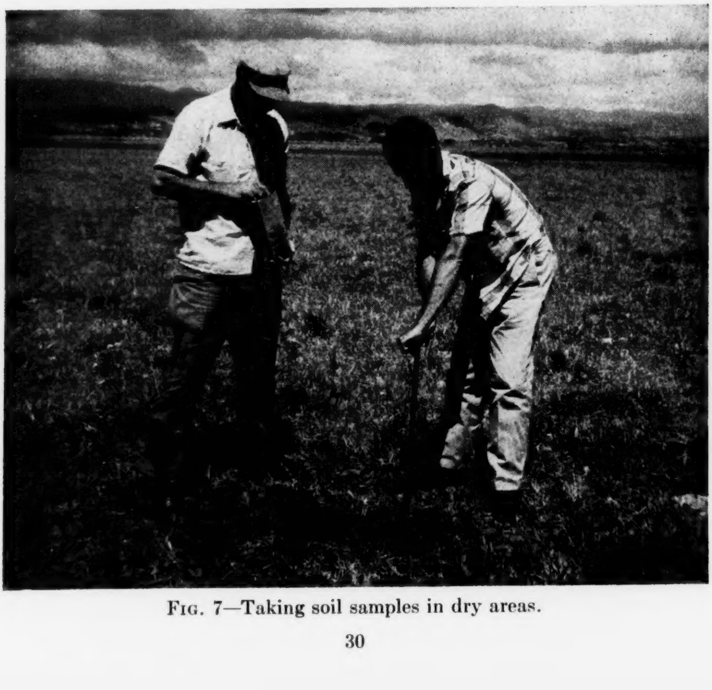

FIG. 7—Taking soil samples in dry areas.

SUMMARY

1. The area of soils surveyed in Lajas Valley was 24,656 acres.

2. The soils were classified into normal, saline, saline-alkali, and non-saline-alkali (table 1) at depths of 0 to 8, 8 to 24, 24 to 48, and 48 to 72 inches, respectively.

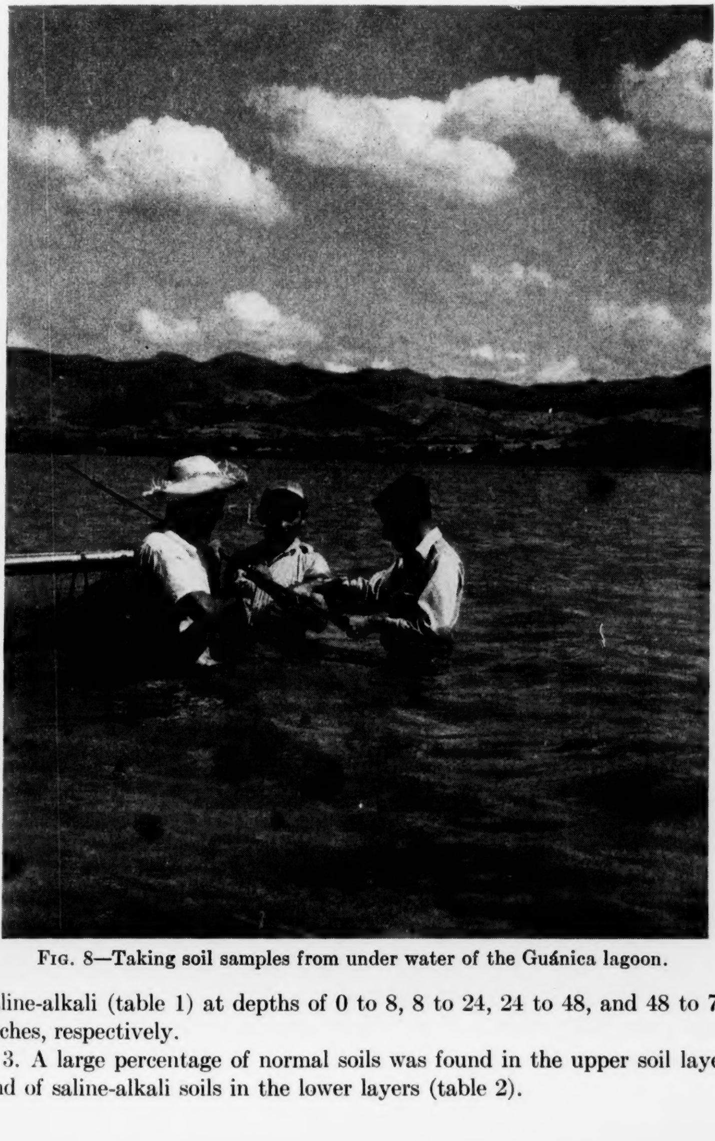

FIG. 8—Taking soil samples from under water of the Guánica lagoon.

3. A large percentage of normal soils was found in the upper soil layer and of saline-alkali soils in the lower layers (table 2).

4. Normal soils occupied about 86 percent of the surface area to a depth of 8 inches and about 63 percent at a depth of 8 to 24 inches.

5. Soils with a salinity problem (table 2) increased from 9 percent at a depth of 8 inches to 28.3, 58.8 and 68.5 percent, respectively, at depths of 8 to 24, 24 to 48, and 48 to 72 inches.

6. The soils with a salinity problem were largely of the saline-alkali class (table 1).

TABLE 1.—*Classification of normal, saline, saline-alkali, and nonsaline-alkali soils ((2) pp. 4-6))*

Soil class	Electrical conductivity (EC) of saturation extract in millimhos/centimeter at 25°C	Exchangeable sodium percentage (ESP) in the soil	Soil pH
Normal	Less than 4.0	Less than 15	Generally less than 8.5
Saline	4 or higher	Less than 15	Usually less than 8.5
Saline-alkali	4 or higher	15 or higher	Seldom higher than 8.5
Nonsaline-alkali	Less than 4.0	15 or higher	Usually between 8.5 and 10.0

TABLE 2.—*Percentages of normal, saline, saline-alkali, and nonsaline-alkali soils according to depth of sampling in 24,656 acres surveyed and sampled in Lajas Valley*

Depth of sampling (inch)	Normal	Saline	Saline-alkali	Nonsaline-alkali
	Percent	*Percent*	*Percent*	*Percent*
0 to 8	85.8	5.2	7.5	1.5
8 to 24	63.4	8.3	20.2	8.1
24 to 48	33.5	7.7	48.5	10.3
48 to 72	24.0	7.5	58.1	10.4

7. In four soil-profile samples (table 3) taken from Lajas Valley, the saturation percentage varied from 58 to 191, the electrical conductivity from 0.8 to 28.4 millimhos per centimeter, the exchangeable-sodium percentage from 2.2 to 46.0, the soil pH from 8.1 to 8.9, the content of gypsum from 0 to 21.9 tons per acre-foot, the gypsum requirement from 0 to 23.8 tons per acre-foot, and the hydraulic conductivity from less than 0.005 to 6.24 inches of water per hour. Higher gypsum contents were found in the deep subsoil layers of two soils (profiles 1 and 4). Amounts of gypsum varying from 9.9 to 20.3 tons per acre-foot of depth, are required for the reclamation of the surface layers of these two profiles. In general, the hydraulic-conductivity values show that the soil-surface layers are more permeable than the subsoil layers.

8. The procedure and methods used in this paper were found to be accurate, simple, rapid, and practical. They are recommended for the coordination of data related to the classification and reclamation of soils affected by salinity problems in the different countries of the world.

TABLE 3.—*Saturation percentage (SP), electrical conductivity (EC), exchangeable-sodium percentage (ESP), soil pH, soil class, gypsum content, gypsum requirement, and hydraulic conductivity (K) of four soil profiles in Lajas Valley*

Profile No. and soil type	Depth	SP	EC	ESP	pH	Soil class	Gypsum		K
							Content	Requirement	
	In.		*Millimhos per centimeter*				*Tons/A.-ft.*	*Tons/A.-ft.*	*In./Hr.*
1. Fraternidad clay	0–10	105	17.5	46.0	8.5	Saline-alkali	0	20.3	0.071
	10–26	89	28.0	40.7	8.4	do.	0	16.8	.082
	26–31	85	28.2	39.9	8.5	do.	0	21.7	
	31–42	88	28.2	36.3	8.4	do.	14.6	5.7	.057
	42–66	92	28.4	37.0	8.4	do.	8.6	6.4	.044
	66–82	95	26.4	39.3	8.5	do.	2.2	10.6	.026
2. Aguirre clay	0–3	88	2.0	3.0	8.3	Normal	0	0	6.240
	3–12	97	1.2	5.1	8.4	do.	0	0	1.750
	12–32	152	1.3	16.0	8.9	Nonsaline alkali	0	13.4	.025
	38–47	191	5.0	37.2	8.9	Saline-alkali	0	23.8	.025
	47–70	160	6.8	45.0	8.8	do.	0	19.6	.057
3. Guánica silty clay loam	0–8	84	.8	2.2	8.1	Normal	0	0	.033
	8–19	112	1.1	11.0	8.9	do.	0	14.7	.041
	19–26	128	2.0	12.5	8.5	do.	0	20.3	<.005
	26–42	130	6.0	24.5	8.3	Saline-alkali	0	21.7	.018
	42–72	110	13.0	30.2	8.4	do.	1.1	18.2	.013
4. Fraternidad clay loam	0–12	58	1.3	8.5	8.2	Normal	0	9.9	.153
	12–25	68	5.5	23.0	8.8	Saline-alkali	0	14.0	.049
	25–31	67	13.0	19.0	8.3	do.	20.1	13.4	
	31–45	72	13.0	18.2	8.4	do.	21.9	11.2	.113
	45–62	96	6.0	28.1	8.8	do.	0	14.0	.080
	62–72	92	6.0	28.3	8.8	do.	0	8.3	.022

RESUMEN

1. El area de los suelos estudiados y clasificados en el valle de Lajas comprende 24,656 acres.

2. Los suelos se clasificaron en normales, salinos, salinos-alcalinos y no salinos-alcalinos a profundidades de 0–8, 8–24, 24–48 y 48–72 pulgadas, respectivamente. (cuadro 1).

3. El por ciento más alto de los suelos normales se encuentra en la capa superior del área estudiada y los salinos alcalinos en las inferiores.

4. Los suelos normales ocupan cerca del 86 por ciento del área hasta una profundidad de 8 pulgadas y alrededor del 63 por ciento a una profundidad de 8 a 24 pulgadas.

5. Los suelos con problemas de salinidad (cuadro 2) aumentaron desde el 9 por ciento, hasta 28, 59 y 69 por ciento, respectivamente, a profundidades de 0–8, 8–24, 24–48 y 48–72 pulgadas.

6. Los suelos que tenían problemas de salinidad pertenecen principalmente a la clase salina alcalina (cuadro 1).

7. En las muestras que se tomaron de 4 perfiles de suelo (cuadro 3), el por ciento de saturación varió desde 58 a 191; la conductividad eléctrica de 0.8 a 28.4 mmhos./cm.; el por ciento de sodio intercambiable de 2.2 a 46.0; el pH del suelo de 8.1 a 8.9, el contenido de yeso de 0 a 21.9 ton/A./pie; el requisito de yeso de 0 a 23.8 ton/A./pie; y la conductividad hidráulica desde menos de 0.005 a 6.24 pulgadas de agua por hora. Se encontraron altos contenidos de yeso en las capas profundas del subsuelo en dos suelos (perfiles 1 y 4). Para la reclamación de las capas superficiales de estos dos perfiles se necesita aplicar cantidades de yeso que fluctúen entre 9.9 y 20.3 ton/A./pie. En general, los valores de conductividad hidráulica señalan que las capas superficiales de los suelos son más permeables que las de los subsuelos.

8. Los resultados de este trabajo indican que el procedimiento y los métodos usados fueron exactos, simples, rápidos, y prácticos y se recomiendan para coordinar datos relacionados con la clasificación y reclamación de los suelos que son afectados por problemas de salinidad en los diferentes países del mundo.

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The Insect Family Japygidae (Order Thysanura) in Puerto Rico

Irving Fox[1]

INTRODUCTION

Members of the family Japygidae lead so obscure a life in the soil that their occurrence in a locality is often not generally known, and this is true as regards Puerto Rico. Since they are pests of sugarcane it seems worthwhile to report a recent finding of the family here.

COLLECTION AND IDENTIFICATION

On May 15, 1956, at about 11:00 a.m., a collecting party consisting of Víctor Medina (School of Medicine), Alfredo Casta Vélez (Commonwealth Department of Health), Edward R. Williams (U. S. Public Health Service), and the writer, in search of breeding places of *Culicoides*, took soil samples from the west shore of the Laguna La Torrecilla at the International Airport, Islà Verde, P. R., close to the Air National Guard Installation. From 24 samples of about 350 gm. of soil each, taken at a depth of about 1 inch, three specimens of a species of Japygidae were recovered after the soil had been passed through No. 20 and No. 80 sieves under water pressure, and treated by the magnesium sulfate technique, which involves the mixing of small portions of the soil in a saturated solution of magnesium sulfate so that organic matter floats to the surface.

To obtain identification of the species, one of the three specimens was sent to Prof. Jean Pagés of the University of Nancy, France, at the suggestion of Miss Grace Glance, of the U. S. National Museum. Prof. Pagés' determination and comments were as follows:

> *Paraiapyx* (*Grassjapyx*) species, *bahianus-brasilianus* group, adult female. The exact specific determination is impossible owing to the lack of correct descriptions; furthermore Silvestri has described as new species or subspecies first or second instar larvae. A revision of the American species of *Grassjapyx* is necessary before we can determine correctly specimens belonging to this subgenus (*1*).[2]

DISCUSSION

In view of Prof. Pagés' comments concerning the uncertain taxonomy in the subgenus *Grassjapyx* Pagés (*2*), it would not be wise at this time to provide this species with a new name. In his catalogue of the Japygidae of the world Silvestri (*3*) listed *Neojapyx insulanus* Silvestri (*4*) from Puerto Rico, but his species came from Culebra Island. So the present finding represents the first record of the family Japygidae from the mainland of Puerto Rico. Very likely there are more species here, as the genera *Parajapyx* and *Neojapyx* include a number of species distributed throughout the Americas (*5*, *6*).

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[2] Italic numbers in parentheses refer to Literature Cited, p. 37.

Ingram, *et al.*, (*7*) placed the soil forms which damage sugarcane in two classes: Those of the first class, among which are included the Japygidae, cut off or gnaw small holes in the roots and prune off root hairs, damaging the root system and checking plant growth, and their gnawing also causes wounds that may provide entry for the causal agents of root rot. Those of the second class include the forms which cause heavy injury to the roots, such as weevils and wireworms. In a survey they made in Louisiana 1 square foot of soil at a depth of 8 inches of a sugarcane field yielded 202 specimens of insects of which 30, or approximately 15 percent, were *Japyx* species.

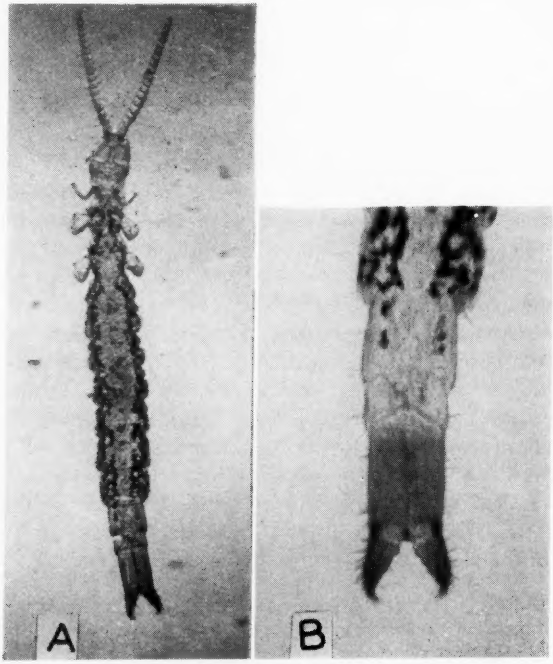

FIG. 1.—A, *Parajapyx* (*Grassjapyx*) species, *bahianus-brasilianus* group; B, the same, posterior portion of the abdomen.

Superficially, japygids resemble earwigs in that the cerci are in the form of forceps; however, they differ obviously in details of the thorax and abdomen and in always lacking wings, as shown in figure 1, A. Particularly characteristic is the rectangular tenth abdominal segment to which the forceps are articulated, as shown in figure 1, B. *Parajapyx* (*Grassjapyx*) species is exceedingly small, measuring only about 3 mm. in length, including the forceps but excluding the antennae. Other species of Japygidae, such as in the genus *Dinjapyx*, may be more than 30 mm. long. The three specimens of *Parajapyx* (*Grassjapyx*) species collected were disposed of as follows: One specimen in the collection of Prof. Jean Pagés; one in the collection of the U. S. National Museum; and one specimen, the photographs of which are shown in figure 1, in the collection of the School of Medicine, School of Tropical Medicine, University of Puerto Rico, San Juan, P.R.

SUMMARY

The insect family Japygidae is reported from the mainland of Puerto Rico and its significance as a sugarcane pest is discussed. The family is represented in Puerto Rico by *Parajapyx* (*Grassjapyx*) species, taken at the Laguna La Torrecilla, Isla Verde, P. R. and *Neojapyx insulanus* Silvestri, known from Culebra Island, P. R.

RESUMEN

El artículo informa la presencia en la isla propia de Puerto Rico de la familia Japygidae de los insectos y discute su importancia como una plaga de las plantaciones de caña de azúcar. Esta familia está representada en Puerto Rico por *Parajapyx* (*Grassjapyx*) especie capturado en las playas de la Laguna La Torrecilla, Isla Verde, P. R. y por *Neojapyx insulanus* Silvestri, ya informado, de la Isla de Culebra, P. R.

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A Review of the Auchenorhynchous Homoptera of Puerto Rico[1]

J. A. Ramos[2]

INTRODUCTION

A taxonomic revision of the auchenorhynchous Homoptera of Puerto Rico has been needed for a long time. This is more clearly evident if an attempt is made to identify specimens by means of the scanty literature available on the subject which proves to be very deficient and largely obsolete for the purpose. Many of the new records gathered during the past two decades are found scattered in nontaxonomic publications of very limited value from the standpoint of the taxonomy of this important group of insects. More intensive collecting and search, especially in the interior of the

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[1] Contribution from the Research Center, College of Agriculture and Mechanic Arts, University of Puerto Rico, Mayagüez, P. R.

This publication is Part III, covering the Kinnaridae, the Cercopidae, the Membracidae, and the Cicadidae, of material published in 1950 by John S. Caldwell and Luis F. Martorell on the Cicadellidae and the Fulgoroidea, except the Kinnaridae.

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The writer was most generously assisted by various persons in his study of the insects included in this report and in the preparation of the manuscript. Without their kind and valuable cooperation both tasks would have been much more difficult.

Dr. J. S. Caldwell of Circleville, O., and Dr. L. F. Martorell, Entomologist, Agricultural Experiment Station of the University of Puerto Rico, kindly put into the hands of the writer all the material of the families under consideration collected by them during the insect survey that they conducted from August 1947 to the middle of January 1948, in relation to the "bunchy-top" disease of papaya.

Dr. George N. Wolcott, Entomologist (ret.), also from the Puerto Rico Agricultural Experiment Station, generously loaned for study specimens from the Station's collection.

Miss Louise M. Russell, Entomology Research Branch, U. S. Department of Agriculture, most kindly put at the writer's disposal for study the specimens of Puerto Rican cercopids, membracids, and cicadids in the U. S. National Museum.

Prof. J. Maldonado Capriles, Biology Department, College of Agriculture and Dechanic Arts of the University of Puerto Rico, assisted the writer in collecting much of the material in his collection and in many other ways.

Much of the taxonomic work was carried out under the advice of the late Dr. Z. P. Metcalf, North Carolina State College, who also offered the writer valuable suggestions in the preparation of this paper.

The author is very deeply indebted to all these persons and wishes to express to each one of them his fullest appreciation and gratitude for his cooperation.

Thanks are also due to Mr. Juan A. Wirshing, Central Mercedita, Ponce, P. R., for his help in providing transportation and other facilities for a collecting trip to Caja de Muertos Island.

Island, have disclosed a rather large number of new or little-known forms which require further study and description. Finally, the discovery of the importance of some species as vectors of plant diseases and the fact that they are very poorly known taxonomically, more than justify a complete review of the Puerto Rican Auchenorhyncha.

In 1950, while working on a survey of the insects associated with the transmission of the "bunchy-top" disease of papaya, Caldwell and Martorell initiated such a revision. These authors are responsible for the sections dealing with the Cicadellidae, Part I, and the Fulgoroidea exclusive of the Kinnaridae, Part II, (12, 13). The present Paper, which comprises the remaining families, namely the Kinnaridae, Cercopidae, Membracidae, and Cicadidae, is a continuation of their work and completes the revision of the entire auchenorhynchous fauna of the Island. As in both of the previous works, Mona Island, although politically a subdivision of Puerto Rico, is excluded from this study because its fauna show closer affinity to that of Hispaniola.

Finally, the author wishes to state that he does not claim this revision of the Kinnaridae, Cercopidae, Membracidae, and Cicadidae of Puerto Rico to be exhaustive. He feels sure that many more forms remain yet to be discovered as the most interesting species of these insects are extremely rare and rather difficult to collect.

SYSTEMATIC ACCOUNT

Suborder Auchenorhyncha

This suborder comprises a vast section of the Homoptera. Many are common and familiar insects such as the planthoppers, leafhoppers, treehoppers, froghoppers, and cicadas. They are characterized chiefly by the possession of a free, three-segmented labium which arises from the posterior ventral margin of the head and extends backward between the coxae. The head is variously modified; the antennae are short, usually bristlelike; the eyes are generally prominent and the number of ocelli may be three, two, or none. The pronotum and mesonotum are usually conspicuous but the metanotum is greatly reduced. There are typically two pairs of wings. The forewings or tegmina are quite characteristic in the various families and other minor groups which mostly exhibit peculiar tegminal venation. The hindwings are usually greatly reduced with the venation much simplified. The legs have three tarsal segments. The abdomen is typically conical in shape, tapering caudad. The female genitalia are complete or incomplete, with a swollen pygofer and usually sawlike ovipositors for inserting eggs in the stems of plants; the tenth segment is distinct, cylindric, and the eleventh segment is small. In the male genitalia the pygofer is more or less cylindric or swollen, sometimes produced posteroventrally into a pair of subgenital plates; the tenth or anal segment is reduced but distinct and usually cylindric, sometimes produced ventrad as an anal spine or spines; the eleventh segment or anal style is greatly reduced.

This work deals only with the families Kinnaridae, Cercopidae, Membracidae, and Cicadidae of the Island. The first family is one of the smallest in the suborder and is distributed mostly in the tropics of the Oriental Region and of the New World, especially in the Caribbean Region. The last three families are of cosmopolitan distribution. They are very familiar insects known respectively as treehoppers, froghoppers, and cicadas.

All the primary types of the new species described in this paper are deposited in the collection of the Department of Entomology of the North Carolina State College of Agriculture and Engineering. Paratypes are deposited in the U. S. National Museum and in the author's collection.

KEY TO PUERTO RICAN FAMILIES OF AUCHENORHYNCHOUS HOMOPTERA

1. Large forms, over 15 mm. in length; three ocelli, forming a small triangle on vertex; males with tympana .... CICADIDAE
1. Smaller, usually much less than 15 mm. in length; at most two ocelli on vertex; males without tympana 2
2. Pronotum greatly developed, usually extending over abdomen MEMBRACIDAE
2. Pronotum not greatly developed, not extended over abdomen 3
3. Base of antennae on sides of head below eyes 5
3. Base of antennae on face in front of or between eyes 4
4. Hind tibiae with a double row of setae .... CICADELLIDAE
4. Hind tibiae with several lateral spines and a circlet of spines at apex CERCOPIDAE
5. Second metatarsal segment not very small, apex more or less truncate with a row of small spines; tegmina without a costal area or with a small one without cross veins 6
5. Second metatarsal segment very small, apex rounded or acute, without a row of spines or with only one spine at either side; tegmina with costal area present or absent, with or without cross veins 10
6. Sixth, seventh and eighth abdominal tergites bearing wax-secreting pores .... KINNARIDAE
6. Sixth, seventh and eighth abdominal tergites not bearing wax-secreting pores 7
7. Hind tibiae with a movable spur or calcar at apex.... ARAEOPIDAE
7. Hind tibiae without a movable spur or calcar at apex 8
8. Fragile, delicate forms; apical segment of labium very short, about as broad as long .... DERBIDAE
8. Robust forms; apical segment of labium distinctly longer than broad. . 9

9. Greatly flattened forms; tegmina usually overlapping apically; claval vein reaching apex of clavus........................ACHILIDAE
9. Not greatly flattened; claval vein entering commissure before apex of clavus..CIXIIDAE
10. Tegmina membranous, transparent; posterior angle of mesonotum with a transverse line or groove....................TROPIDUCHIDAE
10. Tegmina coriaceous, opaque; mesonotum without a transverse line posteriorly..11
11. Clavus distinctly granulate; costal area with many cross veins FLATIDAE
11. Clavus not granulate; costal area, if present, without cross veins....12
12. Tegmina large and broad, steeply tectiform; hind tibiae without preapical spurs; male genitalia bilaterally symmetrical ACANALONIIDAE
12. Tegmina often greatly reduced; hind tibiae with preapical spurs; male genitalia asymmetrical..............................ISSIDAE

FAMILY KINNARIDAE

The members of this family are small fulgorids which superficially resemble the Cixiidae and Meenoplidae in general appearance. They differ in having the male genitalia of an entirely different type with the aedeagus bearing an outer periandrium, in the ovipositors being reduced and incomplete, and in the absence of granulation in the claval area and elsewhere on the tegmina. The females generally bear wax-secreting pores on the sixth, seventh, and eighth abdominal tergites.

KEY TO THE GENERA AND SPECIES OF PUERTO RICAN KINNARIDAE

1. Vein $M_3 + M_4$ of tegmina simple to apex, not forked *Oreopenes luteifacies* sp. n.
1. Vein $M_3 + M_4$ of tegmina forked before apex..................2
2. Aedeagus with two awl-like apical processes abruptly turned upward; lateral processes of anal segment very long and attenuated.........3
2. Aedeagus without awl-like apical processes; lateral processes of segment not very long nor attenuated............................4
3. Tegmina with a broad brown band from middle of costa to commissural margin; aedeagus with only one lateral spine at base *Quilessa fasciata* Fennah
3. Tegmina infuscated on basal half to nodal line; aedeagus with two lateral spines at base......................*Q. heminfuscata* sp. n.
4. General color piceous..7
4. General color tawny or orange, not piceous........................5

5. Male pygofer constricted at sides near middle; general color tawny *Q. collaris* sp. n.
5. Male pygofer not constricted at sides near middle; general color orange 6
6. Anal segment bearing a process on anterior lateral angles; aedeagus tubular, with three spearlike dorsal processes .... *Q. wirshingi* sp. n.
6. Anal segment without a process on anterior lateral angles; aedeagus curved, membranous, with a ventral slit and without lanceolate dorsal processes .... *Q. oraria* sp. n.
7. Aedeagus simple, without spinelike processes; pygofer erect in profile *Q. nahiba* sp. n.
7. Aedeagus with prominent spinelike processes; pygofer oblique in profile 8
8. Tegmina transparent 9
8. Tegmina strongly opaque in part at least 10
9. Male pygofer with sides very strongly constricted at middle; lateral processes of anal segment long and slender; aedeagus with a large lanceolate process at each side .... *Q. pellucidoides* sp. n.
9. Male pygofer with sides moderately constricted at middle; lateral processes of anal segment short; aedeagus with a spinous process arising from the left side .... *Q. pellucida* Fennah
10. Genital plate of female with a lobe on the hind margin, strongly elevated on the disc in line with this lobe .... *Q. tristis* Fennah
10. Genital plate of female without such a lobe 11
11. Costal cell of tegmina completely opaque .... *Q. funebris* Fennah
11. Costal cell of tegmina in part at least transparent ..... *Q. atrata* sp. n.

Oreopenes gen. n.

This genus resembles *Quilessa* Fennah and *Eparmenoides* Fennah. It differs from the former chiefly in having vein $M_3 + M_4$ of the tegmina simple to apex instead of forked, and from the latter principally in the different proportions of the frons and also in the details of the tegmina and wings. The general pattern of the male genitalia is also completely different from that exhibited by these genera.

Vertex about as long as wide; sides slightly widening to base; median and lateral carinae moderately defined. Frons longer than wide; median and lateral carinae prominent. Clypeus longer than wide; lateral and median carinae conspicuous and continuous with corresponding carinae of frons. Pronotum about as long as vertex; anterior margin shallowly sinuate behind eyes, distinctly carinate between eyes and tegulae; posterior margin moderately and rather angularly excavated; disc gradually raised from inner ends of lateral margins, with a conspicuous depression at each side of prominent median carina; lateral carinae almost obsolete. Mesonotum much longer than pronotum; disc moderately convex, tricarinate, all three carinae prominent and nearly parallel. Scutellum depressed; tip acute. Tegmina with sides widening from base, then symmetrically rounded at apex; costal cell broad; common stalk of Sc + R + M about half as long as basal cell; claval suture joined to commissural margin well beyond middle of tegmen; vein $M_3 + M_4$ simple to apex; six apical cells; two anteapical cells. Wings with fourth apical cell bearing a long common stalk.

Anal segment of male short, lateral processes greatly enlarged, incurved distally; aedeagus tubular, enlarged apically, with a dorsal process, genital styles reduced in size, with a prominent anteapical process on dorsal margin.

Genotype: *Oreopenes luteifacies* sp. n.

Oreopenes luteifacies sp. n. (fig. 1, A to H).

A medium-sized species, the head and the thorax fusco-piceous with a metallic green lustre, a conspicuous yellow band at the base of the vertex, another along the entire posterior and lateral borders of the pronotum and a third one along the scutellar margin of the clavus.

Vertex with apex gently arcuate. Frons about one and one-half times as long as wide; base about half as wide as widest part; sides diverging from base, then converging to apex. Clypeus nearly as wide as frons, together with frons slightly convex in profile. Mesonotum strongly convex; apical portion declivous toward sunken scutellum.

Pygofer of male with anterolateral borders broadly lobate at middle, posterolateral borders very irregular, with a long process ventrad of middle longitudinal axis; genital plate longer than broad, lateral margins nearly straight anteriorly but diverging near posterior margin, anterior margin arched, posterior one with a deep broad median emargination; genital styles short and small in proportion to pygofer and anal segment, a large preapical process on dorsal margin bearing a posterior and an anterior short projection, apex with a short blunt extension slightly curved dorsally; aedeagus membranous with a sclerotized rodlike dorsal process ending in an upturned hook; anal segment with lateral processes gradually incurved, an anteapical lobe on dorsal margin, apex forked.

Pregenital plate of female roughly hexagonal, broader than long, convex; valvulae short and broad, with a rounded apex.

Vertex brownish black, a pale yellow band at base which extends along lateral and median carinae for a short distance; frons with basal third brownish black and apical two-thirds ochraceous orange; clypeus and labium pale buff, eyes rufous; first joint of antennae light brown with outer margin paler, second joint dark brown. Pronotum fusco-piceous with

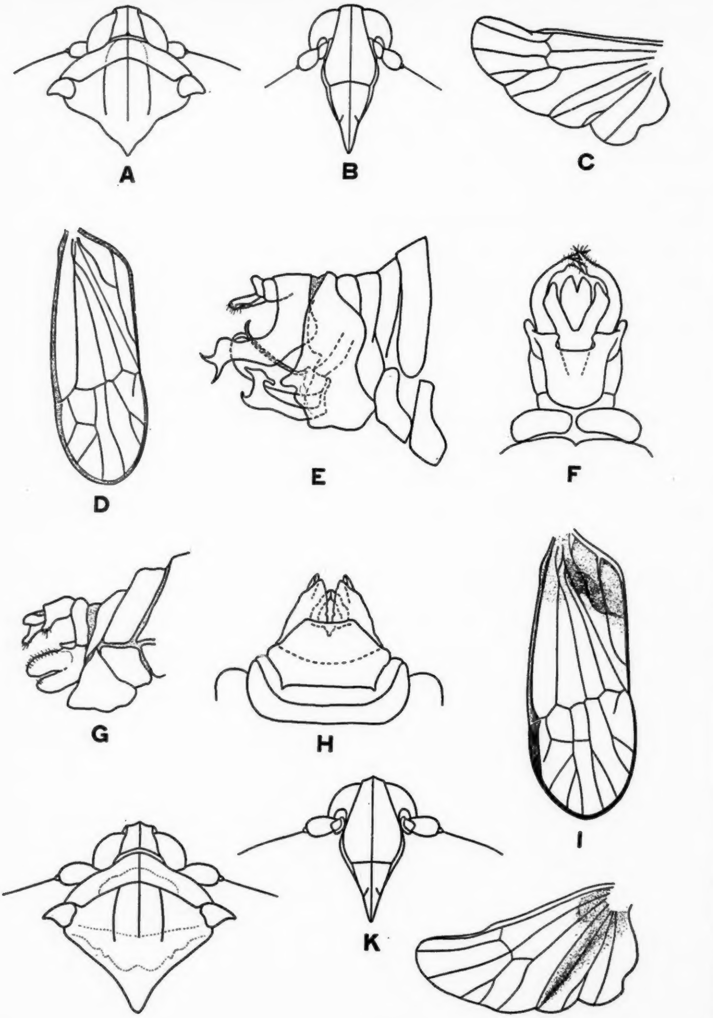

Fig. 1.—A, *Oreopenes luteifacies* sp. n., dorsal view of head and thorax. B, *O. luteifacies* sp. n., frontal view of head. C, *O. luteifacies* sp. n., wing. D, *O. luteifacies* sp. n., tegmen. E, *O. luteifacies* sp. n., lateral view of male genitalia. F, *O. luteifacies* sp. n., ventral view of male genitalia. G, *O. luteifacies* sp. n., lateral view of female genitalia. H, *O. luteifacies* sp. n., ventral view of female genitalia. I, *Quilessa collaris* sp. n., tegmen. J, *Q. collaris* sp. n., dorsal view of head and thorax. K, *Q. collaris* sp. n., frontal view of head. L, *Q. collaris* sp. n., wing.

a greenish tinge and a broad light yellow band along entire hind and lateral borders. Mesonotum and scutellum fusco-piceous with a strong greenish lustre, outer margins stramineous. Tegmina hyaline, basal fourth very weakly infuscated; veins light brown. Wings transparent; veins light brown. Legs ochraceous, coxae brown. Abdomen brown, membrane brownish yellow; genital styles light brown, apices lighter, anal segment whitish.

Length of male to tip of abdomen: 2.50 mm.; tegmen: 2.10 mm.

Length of female to tip of abdomen: 2.85 mm.; tegmen: 2.30 mm.

Holotype ♂: Maricao State Forest, P. R.; 5 November 1952; on "Capá Blanco", *Petitia domingensis* Jacq.; J. A. Ramos.

Allotype ♀: Same data.

Paratypes: 11♂♂: same data as types; 1♂: Maricao State Forest, P. R.; 29 July 1953; at light; J. A. Ramos; 35 ♀♀: same data as types; 2 ♀♀. Barrio Rubias, Yauco-Lares Road, P. R.; 19 November 1952; J. A. Ramos; 9 ♀♀: Maricao State Forest, P. R.; 22 November 1952; J. A. Ramos.

Quilessa Fennah

1942. *Quilessa* Fennah, *Proc. Ent. Soc. Wash.* **44:** 103–4.

This is the largest genus of the Kinnaridae in the West Indies. It was originally described from the Lesser Antilles where several species are known from those islands. The genus is easily separated from other similar genera by the possession of a single carina on the disc of the pronotum and by the tegminal venation which is very characteristic.

The following description of the genus is quoted from Fennah 1942: 103–104:

> Head, with eyes, scarcely two-thirds width of pronotum. Vertex longer than wide, expanding to base, which is shallowly, and usually angularly, excavated; median and lateral carinae well developed, curving uninterruptedly on to the frons; no transverse carina. Frons longer than its widest part, base about half as wide as apex, sides expanding nearly to six-sevenths from base, then subangularly converging to apex, lateral and median carinae distinct. Clypeus at base three-quarters as wide as widest part of frons tapering acutely to apex, median and lateral carinae present; clypeus and apical half of frons somewhat convex, basal part of frons sloping smoothly posteriorly into vertex. No median ocellus; genae somewhat tumid below antennae; no subantennal process; antennae with basal segment very short, second segment slightly longer than broad; eyes widely emarginate ventrally. Pronotum as long as vertex, anterior margin shallowly excavated behind eyes; posterior border shallowly emarginate, curving anteriorly at sides; median carina distinct, lateral carinae of of disc obsolete; a strong carina at each lateral margin between eye and tegula. Mesonotum feebly convex, the three carinae distinctly elevated, apical region strongly concave, tip of scutellum acute. Hind tibiae unarmed. Anal segment of male bifid, often asymmetrically; aedeagus with a ventral keel, often containing a complex sclerotized rod, and often with a process overhanging dorsally. Pygofer with a lateral process. Ovipositor incomplete. Egg bluntly ovoid.

Genotype: *Quilessa lutea* Fennah (**1942:** 103–4), described from St. Lucia. B. W. I.

Quilessa collaris sp. n. (figs. 1, I to L, and 2, A to D).

A medium to large species. General color tawny; the scutellum, lateral margins of the mesonotum, a lunate band on the hind border of the pronotum and the inner border of the clavus conspicuously marked with brownish yellow.

Vertex abruptly widening to base; apex angulate. Frons about one and a half times as long as wide; sides widening from base, then converging to apex which is nearly straight. Clypeus at base narrower than frons, nearly straight in profile. Second joint of antennae very large, slightly surpassing outer angles of pronotum.

Male pygofer narrow in lateral view, anterior and posterior lateral margins smoothly sinuate; genital plate broader than long, anterior margin rounded to sides, posterior margin slightly arched; genital styles larger than anal segment, dorsal and ventral borders sinuate, apex strongly widened and abruptly upturned into a process which extends into an inward and an outward spinelike projections separated by a short lobe; aedeagus keel-shaped, with a membranous covering which projects apically into two long, acute spines and with a ribbonlike obtuse strip dorsally; penis terminating in two long, hooked, asymmetrical, heavily chitinized spines; anal segment short and small, lateral processes narrow, obtuse and incurved, somewhat asymmetrical.

Pregenital plate of female roughly trapezoidal in outline, strongly gibbous on anterior half; valvulae long and narrow, much longer than anal segment, strongly acuminate in ventral aspect.

Vertex tawny with an irregular brown patch on disc where carinae are almost black for a distance which extends into basal third of face; frons and clypeus light tawny, somewhat infuscated at base; eyes brownish black with a narrow rufous rim along margins; first joint of antennae very pale yellow, second joint contrastingly piceous; ocelli red. Pronotum tawny, somewhat infuscated behind eyes, central portion of hind margin forming a broad lunate band of yellow. Mesonotum fuscous on basal two-thirds, gradually fading out to tawny on prescutellar region; outer margins and scutellum yellow; tegulae tawny. Mesopleura dark brown. Tegmina hyaline, infuscated at base, veins light brown, darker in clavus, inner claval margins conspicuously yellow. Wings transparent, basal portion smoky; veins light brown. Legs pale yellow. Abdomen brown, somewhat darker above.

Length of male to tip of abdomen: 2.81 mm.; tegmen: 2.40 mm.

Length of female to tip of abdomen: 2.96 mm.; tegmen: 2.57 mm.

Holotype ♂: San Germán, P. R.; 22 May 1923; G. N. Wolcott.

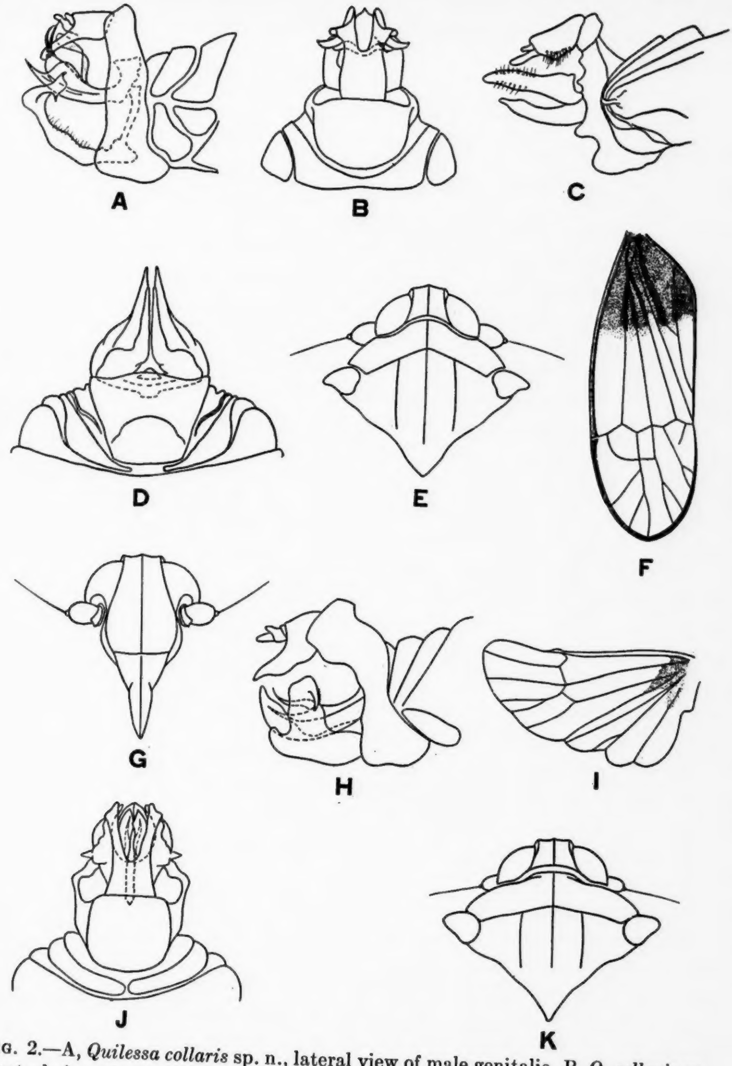

FIG. 2.—A, *Quilessa collaris* sp. n., lateral view of male genitalia. B, *Q. collaris* sp. n., ventral view of male genitalia. C, *Q. collaris* sp. n., lateral view of female genitalia. D, *Q. collaris* sp. n., ventral view of female genitalia. E, *Q. pellucida* Fennah, dorsal view of head and thorax. F, *Q. pellucida* Fennah, tegmen. G, *Q. pellucida* Fennah, frontal view of head. H, *Q. pellucida* Fennah, lateral view of male genitalia. I, *Q. pellucida* Fennah, wing. J, *Q. pellucida* Fennah, ventral view of male genitalia. K, *Q. pellucidoides* sp. n., dorsal view of head and thorax.

Attotype ♀: Maricao State Forest, P. R.; 5 November 1952; J. A. Ramos; 1 ♂: same locality; 27 November 1952; J. A. Ramos.

The peculiar coloration of this species, specially the yellowish collar on the thorax, makes it impossible to be confused with any of the other kinnarids known from the island.

Quilessa pellucida Fennah (fig. 2, E to J).

1945. *Quilessa pellucida* Fennah, *Psyche*, **52:** 126–7.

A pitch-black species of medium size with the basal fourth of the tegmina infuscated, especially on the claval portion which is almost black.

Vertex with apex broadly angled. Frons about one and one-half times as long as wide; sides widening from base, then arching in to nearly straight apex; median carina very prominent. Clypeus at base about one and one half times as wide as frons at base, nearly straight in profile.

Male pygofer oblique in profile, narrower at middle, anterior lateral margin evenly sinuate, posterior one more irregularly so; genital plate roughly quadrangular, anterior and lateral margins slightly arched, posterior margin straight; genital styles more prominent than anal segment, with a narrow, upcurved apical lobe and a large preapical process on dorsal side which extends into an acute projection directed both downward and outward; aedeagus scooplike, ending in an obtuse point, membranous, divided by a ventral slit into two portions, ventral margin curved in profile, penis with an apical strongly chitinized spine and a second similar one arising about one-third from apex on left side, both spines slightly curved dorsally; anal segment with broad lateral processes that gradually extend distally and taper to a blunt point.

General color piceous; eyes with a broad brownish red area around margins; ocelli with a glassy reflection; atennae dark brown. Tegmina hyaline, infuscated on basal fourth, much stronger on claval portion; veins testaceous. Wings transparent, slightly suffused with smoky brown near base; veins brownish.

Length of male to tip of abdomen: 2.54 mm.; tegmen: 2.04 mm.

This species was described originally from a single male collected at Maricao State Forest, P. R. There are seven specimens in the present collection, all males, collected at the same locality on different dates. These specimens have been designated as plesiotypes. *Q. pellucida* Fennah can be readily distinguished from other species of the genus by the coloration of the tegmina.

Quilessa pellucidoides sp. n. (figs. 2, K, and 3, A to E).

A medium-sized piceous species having the basal fourth of the tegmina suffused with reddish brown.

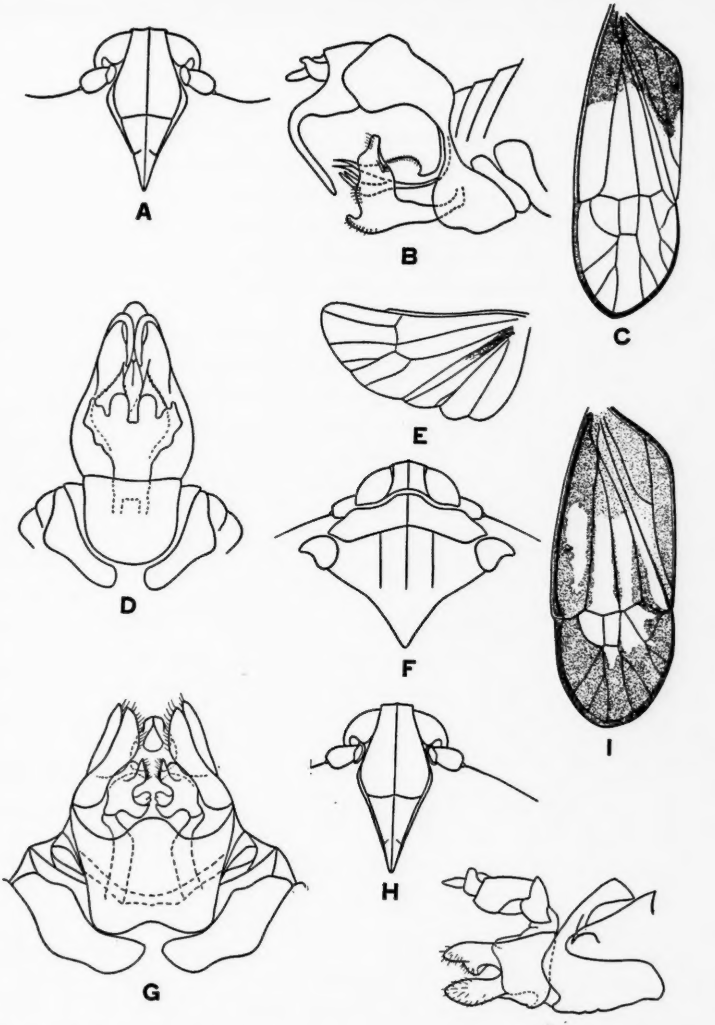

FIG. 3.—A, *Quilessa pellucidoides* sp. n., frontal view of head. B, *Q. pellucidoides* sp. n., lateral view of male genitalia. C, *Q. pellucidoides* sp. n., tegmen. D, *Q. pellucidoides* sp. n., ventral view of male genitalia. E, *Q. pellucidoides* sp. n., wing. F, *Q. tristis* Fennah, dorsal view of head and thorax. G, *Q. tristis* Fennah, ventral view of female genitalia. H, *Q. tristis* Fennah, frontal view of head. I, *Q. tristis* Fennah, tegmen. J, *Q. tristis* Fennah, lateral view of female genitalia.

Vertex with base slightly arched; sides moderately widening to base; apex angulate at middle; median and lateral carinae very prominent. Frons longer than its greatest width; sides diverging from base, then slightly incurving to nearly straight apex; median carina strong, especially on disc. Clypeus broader than long; disc elevated; lateral carinae prominent. Pronotum with anterior margin ecarinate and slightly produced forward behind vertex; sinuate and strongly carinate behind eyes, carinae becoming submarginal behind posterior lateral angles of vertex; disc conspicuously sunken at sides; hind margin very shallowly emarginate. Mesonotum strongly declivous on basal half, sunken mesally from tegulae.

Male pygofer, in profile, rather oblique and very strongly constricted at middle, anterior lateral margin with a broad sinus near middle, posterior one with a deep, large sinus behind constriction; genital plate, in ventral aspect, small, front margin strongly arched, lateral margins nearly straight, hind margin very shallowly emarginate; genital styles somewhat reduced in size, with a short, broad lobe at apex and a comparatively large preapical dorsal process bearing a short, narrow attenuation on anterior border; aedeagus with a narrow, membranous, apically slit, ventral process and two large, asymmetrical, heavily chitinized, lanceolate lateral processes ending in a stinglike spine and bearing numerous short teeth along external margins; anal segment large, lateral processes long, slender, acuminate, sharply bent downward, tips almost touching apical lobes of genital styles.

General color piceous; vertex fuscous at base, especially on basal half of lateral carinae; eyes fusco-rufous; antennae fuscous. Tegmina milky hyaline, basal fourth shaded with reddish brown; veins dark brown, paler distally. Wings milky hyaline, iridescent, slightly infuscated at base; veins light yellowish brown. Legs fuscous. Abdomen nigrescent, first tergite with red streaks on anterior margin, membrane blood red.

Length of male to tip of abdomen: 2.60 mm.; tegmen: 2.12 mm.

Holotype ♂: Maricao State Forest, P. R.: 22 November 1952; J. A. Ramos.

Paratypes: 1 ♂: Maricao State Forest, P. R.; 13 November 1947; J. S. Caldwell and L. F. Martorell; 2 ♂♂: same locality; 5 November 1952: J. A. Ramos; 3 ♂♂: same locality; 27 November 1952; J. A. Ramos; 1 ♂: same locality: 29 July 1953; J. A. Ramos.

Q. pellucidoides sp. n. exhibits a striking superficial resemblance to *Q. pellucida* Fennah. It can be easily separated from this species by the prominent lateral constriction in the male pygofer, the longer lateral processes of the male anal segment, and by the completely different structure of the aedeagus.

Quilessa tristis Fennah (fig. 3, F to J).

1945. *Quilessa tristis* Fennah, *Psyche* **52:** 125.

This is a medium size, piceous species with the tegmina contrastingly marked with black.

Vertex with apex nearly arcuate. Frons a little longer than broad; sides diverging from base, then gradually curving to apex which is much narrower; median carina conspicuously elevated on disc. Clypeus about half as long as frons; base narrower than frons. Pronotum with anterior margin slightly produced behind vertex and slightly sinuate behind eyes; posterior margin shallowly emarginate; disc with a sunken spot at each side of median carina.

Pregenital plate of female broader than long, basal margin sinuate, lateral margins divergent posteriorly, hind margin with a prominent round lobe at middle, disc elevated in line with lobe of hind margin; valvulae broad, obtusely rounded apically, dorsal one with a conspicuous lobe on middle of ventral side.

General color pitch black; lateral carinae of vertex, frons and clypeus brownish black; labium yellowish brown; eyes dark brown with narrow rufous margins; antennae brown. Tegmina strongly shaded with dark brown, especially on basal third, clavus and apical cells, apical half of corium and region of anteapical cells largely transparent, veins dark brown. Wings hyaline, somewhat suffused with light smoky brown; veins dark brown. Front legs testaceous, middle and hind pairs fuscous, abdomen, nigrescent brown, membrane blood red.

Length of female to tip of abdomen: 2.82 mm.; tegmen: 2.53 mm.

This species was originally described by Fennah (1945:125) from a single female taken at Maricao State Forest, P. R. The present collection includes nine specimens, all females, taken at the same locality, 22 and 27 November 1952 and 29 July 1953 (at light); J. A. Ramos. These specimens have been designated as plesiotypes.

The prominent lobe in the posterior margin of the female genital plate with the corresponding raised area of the disc will sufficiently serve to separate this species from its closely related forms, namely *Q. atrata* sp. n. and *Q. funebris* Fennah. The male of this species is not known.

Quilessa atrata, sp. n. (fig. 4, A to G, and also I).

This is another medium-sized species of a pitch-black color with the tegmina marked with black.

Vertex with sides very shallowly sinuate near middle; apex feebly angulate. Frons a little longer than wide; sides diverging from base; apex shallowly emarginate. Base of clypeus narrower than frons. Posterior margin

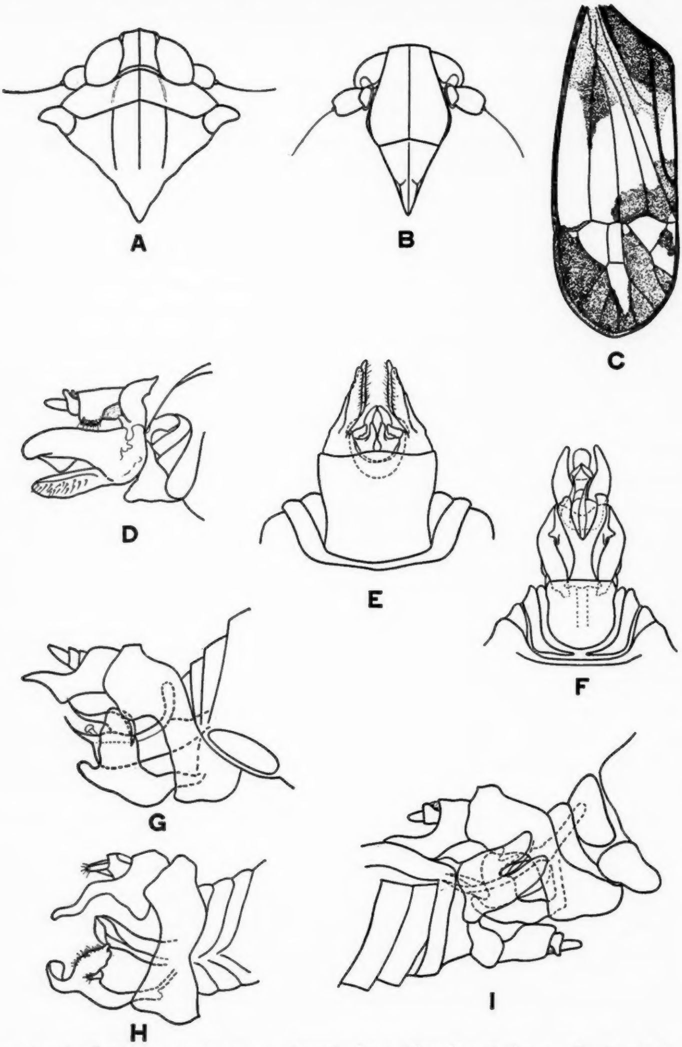

FIG. 4.—A, *Quilessa atrata* sp. n., dorsal view of head and thorax. B, *Q. atrata* sp. n., frontal view of head. C, *Q. atrata* sp. n., tegmen. D, *Q. atrata* sp. n., lateral view of female genitalia. E, *Q. atrata* sp. n., ventral view of female genitalia. F, *Q. atrata* sp. n., ventral view of male genitalia. G, *Q. atrata* sp. n., lateral view of male genitalia. H, *Q. nahiba* sp. n., lateral view of male genitalia. I, *Q. atrata* sp. n., copulation, lateral view.

of pronotum angularly emarginate. Mesonotum moderately flat on disc; sides sloping down; scutellum flat.

Male pygofer oblique in profile, anterior lateral margins moderately sinuate, posterior ones with a wide lobe on upper half directed ventrally; genital plate about as wide as long, anterior margin strongly arched, lateral margins feebly sinuous, posterior margin nearly straight; genital style scooplike, with a fairly wide, rounded apical lobe and a large anteapical dorsal process bearing a membranous prolongation directed outward and downward; aedeagus broad, ventral margin almost straight, abruptly turned upward at apex, dorsal margin somewhat sinuate, ending into an acute, slightly upturned apical spine, left side with a heavily chitinized upcurved spine near middle and a short membranous posterior process; anal segment with lateral processes short and broadened distally.

Genital plate of female large, roughly quadrangular in ventral outline, about as broad as long, convex, lateral margins shallowly sinuate, posterior margin with a short broad lobule at central portion; valvulae proportionately very large and broad, apices broadly rounded.

General color piceous; genae dark brown; ocelli shining, light reddish; eyes light brown, broadly margined with rufous; antennae dark brown. Tegmina shaded with dark brown on basal two-fifths of corium, with black on basal half and apical region of clavus, apical region of corium from vein M to tip of clavus, and on membrane except anteapical cells, basal two-thirds of middle apical cell and inner cell, which is marked on central portion only; veins dark brown. Wings milky hyaline, shaded with dark brown near articulation, where there is also a tiny reddish spot; veins dark brown. Legs yellowish, suffused with dark brown. Abdomen velvety brownish black; membrane reddish; a dark spot of reddish orange at each side on anterior margin of first abdominal tergite. Female terminalia orange yellow.

Length of male to tip of abdomen: 2.66 mm.; tegmen: 2.24 mm.

Length of female to tip of abdomen: 2.85 mm.; tegmen 2.26 mm.

Holotype ♂: Maricao State Forest, P. R.; 14 September 1952; J. A. Ramos.

Allotype ♀: 1 ♀: Alto de la Bandera, P. R.; 25 September 1947; J. S. Caldwell and L. F. Martorell; 1 ♀: Maricao State Forest, P. R.; 14 September 1952; J. A. Ramos; 1 ♀: same locality; 5 November 1952; J. A. Ramos; 2 ♀ ♀: same locality; 27 November 1952: J. A. Ramos.

This species might be confused with *Q. tristis* Fennah or with *Q. funebris* Fennah because of the similar superficial resemblance of these three forms. Differences in the shape and proportions of the female genital plate, as well as the details in the coloration of the tegmina, will readily separate these closely related species.

Quilessa funebris Fennah.

1945. *Quilessa funebris* Fennah, *Psyche* **52:** 127–8.

This is another piceous species with the tegmina almost completely marked with smoky brown.

Genital plate of female subquadrate, twice as broad as long, anterior margin straight, lateral margins in ventral view parallel, posterior margin rather strongly arched; third valvulae fairly broad, dorsal and ventral margins almost parallel, apical margin very oblique; first valvulae about two and one-half times as long as broad, bluntly rounded apically, dorsal and ventral margins weakly arched.

General color piceous; rostrum and legs, except pro- and mesocoxae, testaceous, slightly suffused with fuscous. Tegmina smoky brown, a hyaline spot in middle of corium, between M and Cu_1 extending slightly beyond M towards R, a smaller hyaline spot at base of longest apical cell (M_2), a pale line just distad of nodal line; first subapical and inner margin of posterior subapical cell amost hyaline; veins fuscous. Wings hyaline, very slightly tinged with fuscous; veins fuscous. Membrane of abdomen red.

Length of female to tip of abdomen: 1.70 mm.; tegmen: 2.10 mm.

The above description was prepared from the original one. The species was described and is known only from a single female specimen collected at El Yunque, P. R.; May 1938; by P. J. Darlington.

The tegminal coloration and shape of the female genital plate and of the valvulae will serve to separate immediately this species from *Q. tristis* Fennah and *Q. atrata* sp. n. to which it is very closely related.

Quilessa nahiba sp. n. (figs. 4, H, and 5, A to E, and also K).

A large piceous species with clear tegmina.

Vertex with median and lateral carinae very strongly elevated; apex angulate. Frons conspicuously longer than wide; median carina very strongly elevated. Clypeus nearly as wide as long; base nearly as wide as frons; genae swollen. Pronotum strongly carinate on anterior margin; median carina very prominent, much longer than lateral carinae. Mesonotum moderately convex; scutellum much sunken.

Male pygofer, in profile, rather erect, anterior lateral margins angularly sinuate, posterior one with a broad sinus; genital plate, in ventral view, proportionately small, cup-shaped, posterior margin straight; genital styles long and narrow, with an apical scooplike process directed mesally and a large protuberance arising near middle from dorsal margin and bearing an outward attenuation near base on anterior margin; aedeagus simple, short, nearly cylindrical, somewhat expanded distally; anal segment moderately short but broad, lateral processes long, slender and undulate.

Female genital plate large, broader than long, anterior margin slightly

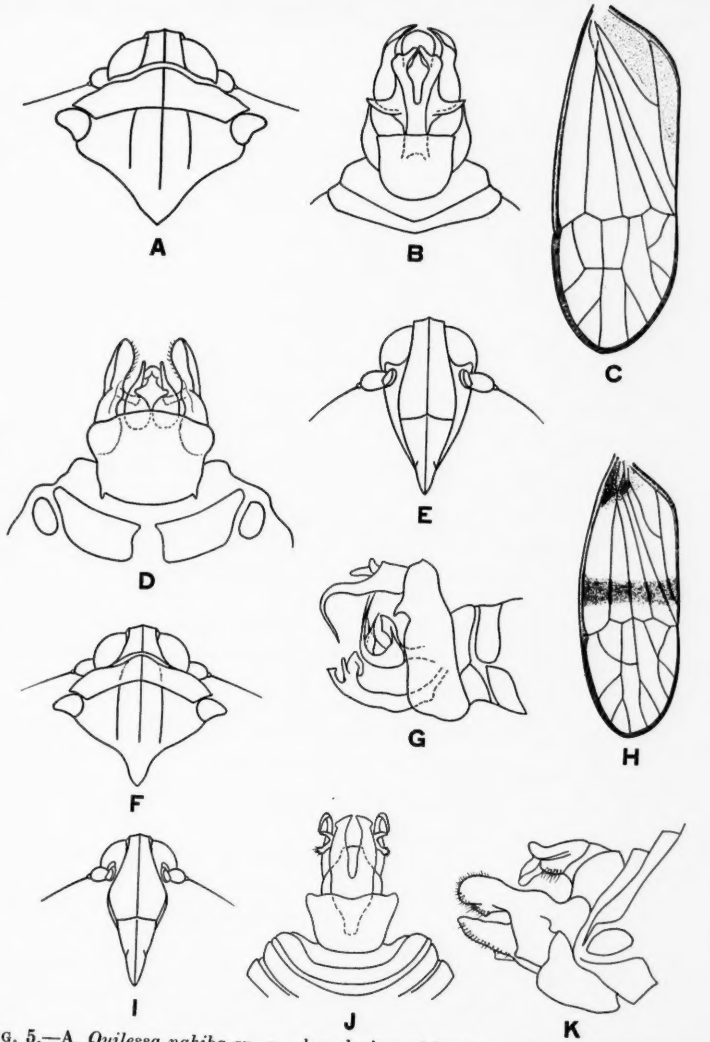

FIG. 5.—A, *Quilessa nahiba* sp. n., dorsal view of head and thorax. B, *Q. nahiba* sp. n., ventral view of male genitalia. C, *Q. nahiba* sp. n., tegmen. D, *Q. nahiba* sp. n., ventral view of female genitalia. E, *Q. nahiba* sp. n., frontal view of head. F, *Q. fasciata* Fennah, dorsal view of head and thorax. G, *Q. fasciata* Fennah, lateral view of male genitalia. H, *Q. fasciata* Fennah, tegmen. I, *Q. fasciata* Fennah, frontal view of head. J, *Q. fasciata* Fennah, ventral view of male genitalia. K, *Q. nahiba* sp. n., lateral view of female genitalia.

concave, lateral margins sinuous, posterior margin slightly convex, posterior lateral angles conspicuously swollen; valvulae greatly enlarged, broad and rounded apically.

General color piceous; base and lateral carinae of vertex, lateral carinae of frons, clypeus, and labium fuscous; genae contrastingly brownish yellow; eyes pinkish brown, black on central portion; antennae dark fuscous. Tegmina hyaline, suffused with brownish yellow on upper inner area of clavus; veins dark testaceous. Wings milky hyaline, slightly suffused with fuscous along anal margin; veins dark brown. Legs dark testaceous. Abdomen dark brown; membrane reddish.

Length of male to tip of abdomen: 2.90 mm.; tegmen: 2.44 mm.

Length of female to tip of abdomen: 3.18 mm.; tegmen: 2.66 mm.

Holotype ♂: Maricao State Forest, P. R.; 27 November 1952; J. A. Ramos.

Allotype ♀: Same locality; 22 November 1952; J. A. Ramos.

Paratypes: 1 ♂: Ponce, P. R.; 10 January 1948; J. Maldonado Capriles; 1 ♂: Doña Juana Forest, Villalba, P. R.; 3 November 1952; J. A. Ramos: 1 ♀: El Yunque, P. R.; 4 April 1947; J. A. Ramos; 1 ♀: Carite Mts., P. R.; 2 October 1947; J. S. Caldwell and L. F. Martorell; 2 ♀ ♀: Maricao State Forest, P. R.; 1 November 1947; J. A. Ramos; 1 ♀: Doña Juana Forest, Villalba, P. R.; 3 November 1952; J. A. Ramos.

This species is readily distinguished from the other local forms of the genus by its piceous color, clear tegmina and very simple aedeagus which does not bear any processes at all.

Quilessa fasciata Fennah (figs. 5, F to J, and 6, A and B).

1945. *Quilessa fasciata* Fennah, *Psyche* **52:** 126.

A small brownish species with a characteristic broad brown band across the middle of the tegmina.

Vertex with apex angulate. Frons about one and one-half times as long as wide; slightly curved; median and lateral carinae distinct. Clypeus at base narrower than frons. Pronotum with anterior border weakly sinuate behind eyes; posterior border deeply emarginate; median carina well defined; lateral carinae obsolescent; a depression between them and median carina.

Male pygofer with anterior lateral margins evenly and smoothly sinuate, posterior ones with a process just above horizontal axis; genital plate roughly cup-shaped in ventral outline, posterior border sinuate; genital styles with a narrow, blunt lobe at apex and an anteapical dorsal process bearing an anterior clavate curved projection, directed downward and outward and an obtuse posterior one pointing dorsad and outward; aedeagus with two large, awl-like terminal spines pointing dorsad, a shorter one at

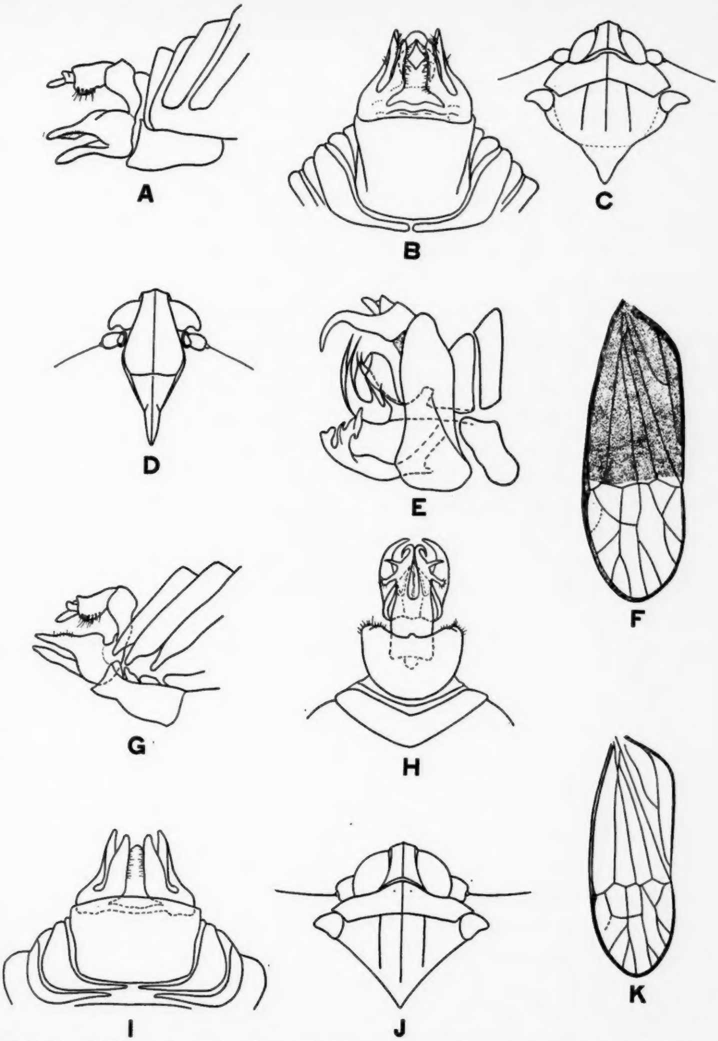

FIG. 6.—A, *Quilessa fasciata* Fennah, lateral view of female genitalia. B, *Q. fasciata* Fennah, ventral view of female genitalia. C, *Q. heminfuscata* sp. n., dorsal view of head and thorax. D, *Q. heminfuscata* sp. n., frontal view of head. E, *Q. heminfuscata* sp. n., lateral view of male genitalia. F, *Q. heminfuscata* sp. n., tegmen. G, *Q. heminfuscata* sp. n., lateral view of female genitalia. H, *Q. heminfuscata* sp. n., ventral view of male genitalia. I, *Q. heminfuscata* sp. n., ventral view of female genitalia. J, *Q. oraria* sp. n., dorsal view of head and thorax. K, *Q. oraria* sp. n., tegmen.

sides near anterior end, and a membranous, hooklike dorsal covering; penis ending in two sharp, asymmetrical spines; anal segment proportionately large, lateral processes very long and slender, tapering to a narrow point and acutely arched downward and forward.

Genital plate of female large, roughly square-shaped; valvulae a little shorter than genital plate, narrow, tapering distally.

Vertex testaceous, marked with fuscous between carinae; frons testaceous orange; clypeus and labium stramineous; eyes fuscous, bordered with rufous; antennae fusco-testaceous. Pronotum fuscous; median carina, anterior margins behind eyes, lateral margins and posterior and lateral borders testaceous. Mesonotum fuscous, lateral margins reddish yellow; tip of scutellum pale yellow. Tegulae fuscous, inner margins testaceous. Tegmina testaceous-hyaline, suffused with fuscous near base, with a broad fuscous band across middle from costa to commissural margin; veins yellowish brown, paler on membrane. Wings hyaline, somewhat infuscated on anal area; veins brownish. Pleurites dark brown; legs light yellow. Abdomen fuscous; membrane orange red.

Length of male to tip of abdomen: 2.19 mm.; tegmen: 1.80 mm.

Length of female to tip of abdomen: 2.37 mm.; tegmen: 1.93 mm.

This species was originally described by Fennah (1945:126) from two female specimens collected at Maricao State Forest, P. R. The present collection includes the following specimens:

1 ♂: Mayagüez, P. R.; 6 April 1940: W. E. Lang; 1 ♂: Guánica State Forest, P. R. 20 September 1952; J. A. Ramos; 3 ♀♀: same locality; 11 November 1952; J. A. Ramos.

These specimens have been designated as plesiotypes.

This species is easily recognized by the characteristic brown band across the middle of the tegmina.

Quilessa heminfuscata sp. n. (fig. 6, C to I).

A small dark-brown species with the tegmina conspicuously suffused with reddish brown from base to nodal line.

Vertex with apex angulate; disc deeply sunken between carinae. Frons about one and a half times as long as wide; apical half inflated in profile. Clypeus short, twice as wide as base of frons. Pronotum with anterior margin well excavated behind eyes; central portion moderately produced anteriorly; posterior margin deeply and angularly emarginate. Lateral borders of pronotum behind tegulae flat and sunken.

Male pygofer with anterior and posterior lateral margins shallowly and smoothly sinuate; genital plate broadly semilunar in outline, posterior margin with a short, small lobule on center; genital styles with a complicated terminal structure divided by a deep sinus into a smaller bilobed apical extension and an anteapical dorsal process that ends in a short spine and a broad lobe, both directed upward and outward; aedeagus with two large, awl-shaped terminal spines curved upward, two similar but smaller anterior ones and a membranous, hoodlike dorsal covering; penis ending in two sharp and short spines; anal segment short and broad, lateral processes long and narrow, sharply curving mesally.

Genital plate of female roughly quadrangular in ventral view, one and a half times as broad as long, anterior margin almost straight, lateral margins sinuate, posterior margin slightly arched; valvulae long and tapering to a rounded point.

General color dark reddish brown, somewhat nigrescent on mesonotum. Frons yellowish brown; clypeus and labium pale yellowish brown. Tegmina strongly suffused with reddish brown from base to nodal line, membrane yellowish hyaline; veins and margins dark brown, becoming yellowish brown in membrane. Wings brownish hyaline; veins yellowish brown. Legs pale stramineous. Abdomen dark brown; membrane reddish; genital styles and lateral processes of anal segment whitish.

Length of male to tip of abdomen: 2.37 mm.; tegmen: 1.90 mm.

Length of female to tip of abdomen: 2.44 mm.; tegmen: 1.94 mm.

Holotype ♂: Aibonito P. R.; 20 March 1940; W. E. Lang.

Allotype ♀: Peñón Collao, Cayey, P. R.; 9 September 1947; J. S. Caldwell and L. F. Martorell.

Paratypes: 1 ♂: Cayey, P. R.; 11 September 1947; J. S. Caldwell and L. F. Martorell; 1 ♀: Same data as allotype.

This species might be readily recognized by the color of the tegmina. It is very closely related to *Q. fasciata* Fennah, both species having the same general aedeagal pattern.

Quilessa oraria sp. n. (figs. 6, J and K, and 7, A to G).

A small species of a uniform orange-buff color and clear tegmina. The female tegmina have a brown oval spot at the stigma.

Vertex with sides sharply widening to base; median and lateral carinae strongly elevated. Frons longer than wide, inflated in profile. Clypeus and labium together shorter than frons; base about twice as wide as frons at base, somewhat inflated; lateral carinae thin and prominently elevated. Posterior margin of pronotum shallowly emarginate; median carina not prominent; disc with a deep puncture on anterior region at each side of median carina. Mesonotum with disc slightly convex; median and lateral carinae running almost to hind border, especially median one which is longer.

Male pygofer short, posterior lateral border with two strong processes separated by a wide and deep sinus; genital styles with two long, narrow,

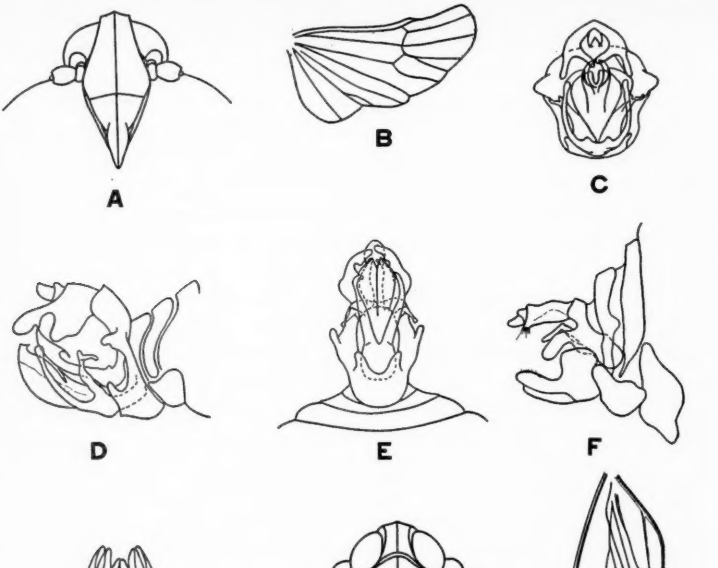

FIG. 7.—A, *Quilessa oraria* sp. n., frontal view of head. B, *Q. oraria* sp. n., wing. C, *Q. oraria* sp. n., posterior view of male genitalia. D, *Q. oraria* sp. n., lateral view of male genitalia. E, *Q. oraria* sp. n., ventral view of male genitalia. F, *Q. oraria* sp. n., lateral view of female genitalia. G, *Q. oraria* sp. n., ventral view of female genitalia. H, *Q. wirshingi* sp. n., dorsal view of head and thorax. I, *Q. wirshingi* sp. n., tegmen. J, *Q. wirshingi* sp. n., frontal view of head. K, *Q. wirshingi* sp. n., ventral view of male genitalia. L, *Q. wirshingi* sp. n., lateral view of male genitalia.

rodlike processes projecting backward and upward, anterior one with a blunt, slender extension bent acutely forward and outward, posterior one clavate; aedeagus with a ventral slit, thin and membranous, dorsal margin with a spine near middle, tip blunt; penis membranous, tip pointed and with an anteriorly directed, curved spine on dorsal side; anal segment large, sides expanding into two wide lobes separated by a deep sinus and a small lobe-like process, posterior lobe incurved.

Pregenital plate of female over twice as wide as long, anterior margin strongly sinuate, lateral margins sinuate and diverging, posterior margin nearly straight.

General color orange buff; eyes brownish gray on central portion; pronotum lighter. Tegmina and wings hyaline; veins brownish yellow. Tegmina of female with a small, dark brown spot on stigma. Legs pale yellow. Abdomen reddish orange.

Length of male to tip of abdomen: 2.22 mm.; tegmen: 1.78 mm.

Length of female to tip of abdomen: 2.30 mm.; tegmen: 1.93 mm.

Holotype ♂: Guánica Forest, P. R.; 11 October 1947; J. A. Ramos.

Allotype ♀: Guánica Forest, P. R.; 11 November 1952; J. A. Ramos.

Paratypes: 1 ♂ and 1 ♀: Same data as holotype.

The orange color of this species will serve to separate it from all other local forms of the genus with the exception of *Q. wirshingi* sp. n. From this species it can be readily distinguished by the details of the male and female genitalia.

Quilessa wirshingi sp. n. (figs. 7, H to L, and 8, A and B).

A small ochraceous orange species with yellowish translucent tegmina. The female has a brown spot on the stigma of the tegmina.

Vertex with apex rounded. Frons longer than wide; base about half as wide as apex; median carina strongly elevated. Clypeus about half as long as frons. Pronotum with anterior margin produced behind vertex.

Male pygofer, in profile, somewhat oblique and narrow, constricted in lower half, anterior lateral margins broadly sinuate, posterior lateral margins bearing a long, narrow dorsally pointed process below constriction and, well above it, a thin, membranous, blunt one which is folded in and concealed; genital plate small, wider than long, front margin strongly arched, lateral margins slightly diverging, hind margin strongly curved, with a short, obtuse process at each side; genital styles long and narrow in profile, ending in a long, slender apical process directed upward and backward, and a similar but shorter one with a low, wide lobe anterior to it on dorsal margin near middle; aedeagus elongated, keeled ventrally, broadly rounded and expanded apically, with minute, toothlike spines at sides near middle and three dorsal, elongate, spearlike, heavily chitinized proc-

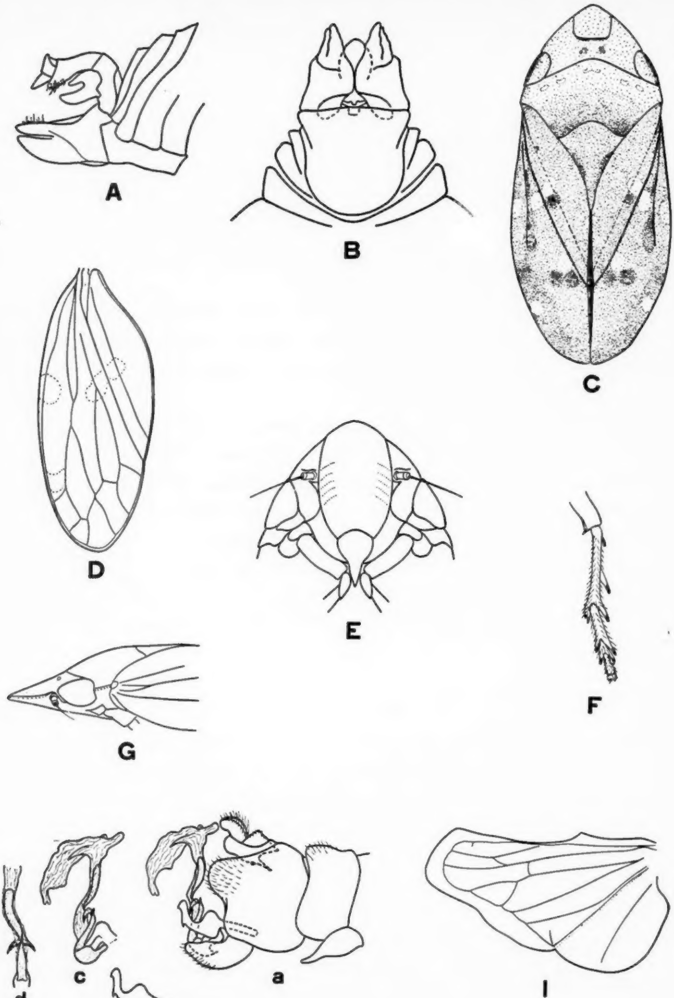

FIG. 8.—A, *Quilessa wirshingi* sp. n., lateral view of female genitalia. B, *Q. wirshingi* sp. n., ventral view of female genitalia. C, *Leocomia uprae* sp. n., dorsal view. D, *L. uprae* sp. n., tegmen. E, *L. uprae* sp. n., frontal view. F, *L. uprae* sp. n., hind leg. G, *L. uprae* sp. n., lateral view of head and thorax. H, *L. uprae* sp. n. (a) Lateral view of male genitalia; (b) Lateral view of genital style; (c) Aedeagus; (d) Detail of aedeagus. I, *L. uprae* sp. n., wing.

esses on dorsal side; anal segment moderately long and broad, anterior lateral angles extended into an elongated projection, lateral processes very large, somewhat asymmetrical, sharply bent downward, with a broadened anteapical lobe on anterior border, terminating in a slender attenuation.

Female genital plate about as broad as long, frontal margin strongly arched, lateral margins slightly sinuate, hind margin nearly straight; valvulae large, broadly rounded apically.

General color ochraceous orange; median and lateral carinae of vertex, pronotum, and tegulae yellow ochre. Tegmina yellow-hyaline; veins yellowish; female with an oval brown spot on stigma, a narrow brown suffusion below costa near nodus, and with apical border of membrane slightly shaded with fuscous. Legs light tawny. Abdomen dark brown; membrane orange red.

Length of male to tip of abdomen: 1.40 mm.; tegmen: 1.70 mm.

Length of female to tip of abdomen: 1.63 mm.; tegmen: 1.88 mm.

Holotype ♂: Caja de Muertos Island, P. R.; 5 December 1947; J. S. Caldwell and L. F. Martorell.

Allotype ♀: Same data.

Paratypes: Same data. 2 ♀♀.

This species may be confused only with *Q. oraria* sp. n. The different male and female genitalia will readily separate these two closely related forms.

The writer takes great pleasure in naming this species after Juan A. Wirshing, of Ponce, P. R., in recognition of his friendliness and attentiveness to biologists visiting Caja de Muertos Island, a place which he has endeavored to develop into a sanctuary of natural history.

FAMILY CERCOPIDAE

The members of this family may be readily recognized by the hind tibiae, which characteristically possess one or two prominent marginal spines and a circlet of strong spines at the apex. The insects are of small or medium size, generally of somber coloration but usually with strongly contrasting spots or markings of vivid colors. The head is strongly deflexed, with two ocelli on the crown; the face is usually inflated. The pronotum is prominent but not greatly enlarged; the scutellum is of moderate size. The tegmina are strongly opaque or coriaceous with the venation sometimes greatly obscured. The wings are large and membranous. The hind legs are usually elongate and well adapted for leaping.

The nymphs are striking from the fact that they live inside a characteristic mass of a frothy, spittlelike secretion which apparently serves for protection.

KEY TO THE GENERA AND SPECIES OF PUERTO RICAN CERCOPIDAE

1. Apex of clavus acute; form elongate, not globose..................5
1. Apex of clavus broadly rounded; form globose. . Genus *Clastoptera* Germar...2
2. Strongly bicolored..3
2. More or less uniformly colored.................................4
3. Contrastingly black and yellow above; crown comparatively short, frontoclypeus not protuberant anteriorly *Clastoptera flavidorsa* Metcalf and Bruner
3. A broad brown band transversely dividing the yellow portion on back; crown comparatively longer, frontoclypeus distinctly protuberant *Clastoptera signifera* (Walker)
4. Color piceous, size very small............*Clastoptera diminuata* sp. n.
4. Color fulvous, size larger..................*Clastoptera martorelli* sp. n.
5. Head flattened, crown with anterior margin thin and foliaceous; face straight and nearly horizontal in profile.........................6
5. Head thick, shorter, crown with anterior margin not thin or foliaceous; face more or less convex in profile..............................7
6. Size less than 5.00 mm.; tegmina broad, apex broadly rounded *Leocomia uprae* sp. n.
6. Size over 5.00 mm.; tegmina narrower, apex somewhat pointed *Leocomiopsis scaramuzzai* Metcalf and Bruner
7. Size less than 4.00 mm.; form elongate and slender *Asprocranites variegata* sp. n.
7. Size about 7.00 mm.; form broad..........*Gaetopsis juanalis* sp. n.

Leocomia Ball

1919. *Leocomia* Ball, *Proc. Iowa Acad. Sci.* **26:** 148–9.

This genus is apparently restricted to the Greater Antilles. It may be readily recognized by the elongate, depressed general form of the body. The head is much flattened, with the anterior border very thin and foliaceous. The tegmina are broad, elongate, with the apex rounded. The aedeagus terminates in an enlarged, amorphous, membranous structure.

Head narrower than pronotum, produced and foliaceous anteriorly; crown rather flat, roughly triangular or paraboloid in outline; ocelli very small, nearer to each other than to eyes and closer to posterior margin than to anterior one; face very flat, with ventral margin nearly horizontal and almost at same level of costal border of tegmina when seen in profile; postclypeus with anterior margin very slightly swollen, transverse ridges usually obsolescent. Pronotum wide, slightly but definitely convex above; anterior margin arched; anterolateral margins short; posterolateral margins slightly sinuous; posterior margin moderately or deeply emarginate. Scutellum large, longer than wide, its length greater than median length of pronotum; sides slightly curved and narrowing to an elongate, acute apex. Tegmina elongate; broadly rounded apically; venation as in *Aphrophora* Germar but with third anal vein absent. Wings with four apical cells; submarginal vein not sinuate. Posterior tibiae with two preapical spines, second much stronger. Aedeagus elongate, terminal portion coiled, membranous, thin and fibrous.

Genotype: *Leocomia parabolocrata* Ball (**1919:** 149), described from Port-Au-Prince, Haiti.

Leocomia uprae sp. n. (fig. 8, C to I).

1917. *Epicranion championi* Van Zwaluwenburg, *J. Econ. Ent.* **10:** 516.
1923. *Epicranion championi* Wolcott, *J. Dept. Agr. P. R.* **7:** 257.
1935. *Epicranion championi* Osborn, *Sci. Surv. Porto Rico and Virgin Islands* **14:** 127.
1936. *Epicranion championi* Wolcott, *J. Agr. Univ. P. R.* **20:** 75.
1950. *Epicranion championi* Wolcott, *J. Agr. Univ. P. R.* **32:** 103.

This is an elongate species of moderately large size and strongly produced crown. It shows the general form and appearance of *L. balloui* Metcalf and Bruner but it is somewhat stouter and of a different coloration. The species may be easily distinguished from this, as well as from other similar forms, by the internal male genitalia, which is very characteristic.

General form moderately robust, rather elongate, slightly over two and a half times as long as broad. Head distinctly narrower than pronotum, paraboloid, sides continuing curve of outer border of eyes in dorsal view, extreme apex rounded and slightly raised, margins very thinly carinate, surface sculptured, with very short pubescence; ocelli very small, slightly closer to each other than to eyes, well separated from hind border of crown but about five times closer to it than to anterior border; entire face completely flat, densely covered with short, appressed hairs; postclypeus almost one and a half times as long as broad, sides gently arched, transverse ridges well defined. Pronotum twice as broad as long, moderately convex, anterior submarginal depressions distinct, entire surface similar to that of crown, anterior lateral margins strongly carinate. Scutellum about one and one-half times as long as pronotum along median line; basal half sculptured and pilose; terminal half pubescent. Tegmina about two and one-third times as long as broad; venation completely obscure; entire surface densely pubescent. Legs, especially tibiae, covered with long, abundant hairs; first preapical spine of hind tibiae much weaker than second.

Male pygofer large, robust; posterior margin strongly bilobed in lateral view; sternal plate small, short, scooplike, with ventral margin strongly arched; styles much widened near middle, posterior process narrow, upcurved, bearing a small short spine on ventral margin, apex slightly rounded; aedeagus greatly enlarged, terminal portion forming an amorphous, transparent, membranous structure, base with a long, chitinized, rodlike process, median area with a narrow, chitinized, ribbonlike appendage on anterior aspect and two small, spurlike processes below it.

General color uniform light yellowish buff to dark yellowish brown. Head, anterior half of pronotum and disc of scutellum lighter on dark forms. Tegmina with a pale irregular arc from center of costa to middle of clavus and a similar marking on costal margin well before apex; these markings obsolescent in pale forms. Face concolorous with head, dark brown or almost black. Entire pubescence golden yellow above except on pale markings and on face where it is whitish.

Nymphs light yellowish; eyes brownish black.

Length to tip of tegmina, ♂: 4.52 mm., ♀: 4.89 mm.; width, ♂: 1.70 mm., ♀: 1.89 mm.

Holotype ♂: Consumo, P. R.; 5 October 1952; on *Psidium Guajava* L.; J. A. Ramos.

Allotype ♀: Same data.

Paratypes 1 ♂: Río Piedras, P. R.; 3 November 1917; R. T. Cotton; 1 ♂: Rosario, P. R.; 12 July 1936; J. A. Ramos; 1 ♂: Jayuya, P. R.; 20 November 1945; W. González; 1 ♂: Carite Mts., P. R.; 2 October 1947; J. S. Caldwell and L. F. Martorell; 1 ♂: Cambalache Experimental Forest, P. R.; 7 October 1947; J. S. Caldwell and L. F. Martorell; 3 ♂♂; Peñón Collao, Cayey, P. R.; December 1947; J. S. Caldwell and L. F. Martorell; 2 ♂♂; El Yunque, P. R.; 12 December 1947; J. S. Caldwell and L. F. Martorell; 6 ♂♂: same data as types; 1 ♂: Lares, P. R.; 2 November 1952; J. A. Ramos; 1 ♀: Río Piedras, P. R.; 1 January 1947; R. Olivencia; 1 ♀: Maricao State Forest, P. R.; 29 March 1947; J. A. Ramos: 2 ♀♀: Río Abajo Forest, P. R.; 20 September 1947; J. A. Ramos; 3 ♀♀: Peñón Collao, Cayey, P. R.; 4 December 1947; J. S. Caldwell and L. F. Martorell; 9 ♀♀: same data as types; 6 ♀♀: Maricao State Forest, P. R.; 27 November 1952; J. A. Ramos.

This is the most common and abundant cercopid in Puerto Rico. It occurs all over the island on *Psidium Guajava* L., coffee, *Inga vera* Willd., and several other host and food plants. It has been repeatedly reported under the name *Epicranion championi* Fowler, an entirely different Central American species. All previous records under this name should hence be referred to *Leocomia uprae* sp. n.

Leocomiopsis Metcalf and Bruner

1944. *Leocomiopsis* Metcalf and Bruner, *J. Elisha Mitchell Sci. Soc.* **60:** 119–20.

This genus is closely allied to *Leocomia* Ball. It differs principally in the more elongate form and general appearance, in having the tegmina proportionately narrower and more pointed apically and in possessing a very different male genitalia.

General form elongate and moderately narrow. Head, including eyes, almost as broad as anterior margin of pronotum, strongly flattened and rather foliaceous anteriorly; crown flat, anterior border carinate; ocelli inconspicuous, decidedly closer to each other than to eyes; face, when seen in profile, very flat, nearly horizontal and lying on same level as costal margin of tegmina; postclypeus very slightly projecting beyond anterior curvature of crown, longer than wide, lateral ridges distinct. Pronotum comparatively longer than in *Leocomia* Ball, moderately convex, finely sculptured above; anterior margin broadly rounded; anterolateral borders feebly oblique, carinate; posterolateral borders sinuous, very thinly carinate; posterior border deeply emarginate. Scutellum large, longer than pronotum, slightly convex; lateral margins carinate; apex pointed. Tegmina elongate, sides subparallel, apex roughly subacute; venation as in *Leocomia* Ball, third anal vein absent. Wings as in *Leocomia* Ball. Hind tibiae with first marginal spine weak, close to base; second much stronger, near middle.

Male pygofer short and broad; sternal plate narrow; styles prominent; aedeagus very large, mostly membranous and transparent, coiled, with a pair of lateral processes at base and a pointed, chitinized, prominent spine at apex.

Genotype: *Leocomiopsis scaramuzzai* Metcalf and Bruner, originally described from Cuba.

Leocomiopsis scaramuzzai Metcalf and Bruner (fig. 9, A to F).

1944. *Leocomiopsis scaramuzzai* Metcalf and Bruner, *J. Elisha Mitchell Sci. Soc.* **60:** 120.

1950. *Epicranion championi* Wolcott, *J. Agr. Univ. P. R.*, **32:** 103.

This species may be readily distinguished from all other Puerto Rican cercopids by the large size, the elongate and depressed general form of the body, the strongly produced head, and the uniform reddish brown color.

General form distinctly elongate, about two and one half times as long as wide across shoulders; sides nearly parallel. Head a little narrower than pronotum, much flattened; crown well-produced anteriorly, rather foliaceous, decidedly shorter than pronotum, acutely rounded apically; sides

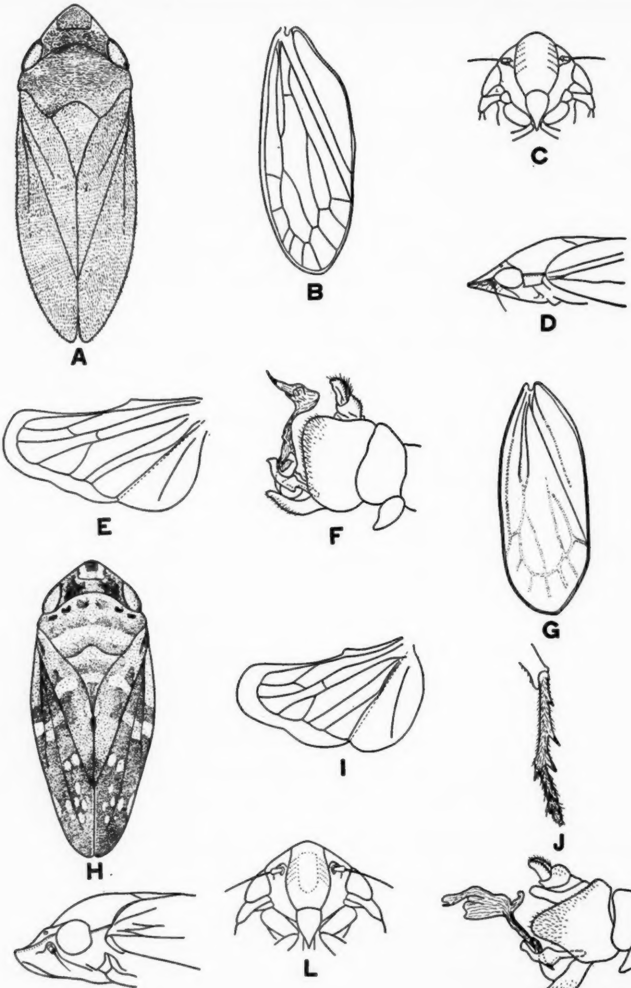

FIG. 9.—A, *Leocomiopsis scaramuzzai* Metcalf and Bruner dorsal view. B, *L. scaramuzzai* Metcalf and Bruner, tegmen. C, *L. scaramuzzai* Metcalf and Bruner, frontal view. D, *L. scaramuzzai* Metcalf and Bruner, lateral view of head and thorax. E, *L. scaramuzzai* Metcalf and Bruner, wing. F, *L. scaramuzzai* Metcalf and Bruner, lateral view of male genitalia. G, *Asprocranites variegata* sp. n., tegmen. H, *A. variegata* sp. n., dorsal view. I, *A. variegata* sp. n., wing. J, *A. variegata* sp. n., hind leg. K, *A. variegata* sp. n., lateral view of head and thorax. L, *A. variegata* sp. n., frontal view. M, *A. variegata* sp. n., lateral view of male genitalia.

slightly arched; surface finely sculptured; ocelli very close to hind border. Pronotum not quite twice as broad as long; anterior margin broadly rounded; anterolateral borders carinate, oblique, rather long; dorsum moderately convex; surface finely sculptured, tending to become rugulose on posterior half; submarginal depressions behind anterior border almost obsolete. Scutellum conspicuously longer than pronotum; sides very faintly curved and distinctly carinate; surface slightly convex, pubescent. Tegmina relatively narrow, apex obtusely pointed; veins distinct; entire surface pubescent.

Male pygofer, in lateral view, much broader than long dorsal margin slightly sinuate; ventral margin rounded; posterior margin nearly straight, upper posterior angle rounded; sternal plate very narrow, obtusely pointed, scooplike; styles broadest at middle, curved up apically, apex rather blunt; aedeagus very membranous, with a short, spine-like process at each side near base; membranous apical portion ending in a prominent, sharp, chitinized spine.

General color uniform reddish brown covered with dense, short, yellowish pubescence. Wings hyaline; veins dark brown.

Length to tip of tegmina, ♂; 5.50 mm., ♀ : 6.30 mm.; width, ♂: 2.00 mm., ♀ : 2.37 mm.

The record of this species is based on the following specimens at hand: 2 ♂♂: Camuy, P. R.; 2 October 1940 on "Jagüey", *Ficus Stahlii* Warb.; G. N. Wolcott and L. F. Martorell; 1 ♂ and 4 ♀ ♀ : Tallaboa, P. R.; 28 August 1947; on *Ficus laevigata* Vahl; J. S. Caldwell and L. F. Martorell; 1 ♀ : Maricao State Forest, P. R.; 14 September 1952; J. A. Ramos.

Asprocranites gen. n.

This genus superficially resembles *Dasyoptera* Metcalf and Bruner but is more elongate and depressed in form. The head is more pointed and prolonged anteriorly; the crown is very uneven, with conspicuous depressions and callosities; the face is not flat but swollen, with the postclypeus sulcate longitudinally along the median line.

General form elongate, depressed. Head, with eyes, narrower than pronotum, moderately projected anteriorly; crown very uneven, with deep depressions and callosities; anterior margin subacutely curved, carinate; extreme apex very slightly projecting outward; ocelli very prominent, closer to each other than to eyes and very close to posterior margin; eyes moderately large; face moderately swollen, postclypeus longer than broad, shallowly sulcate along median line, lateral striations rather indistinct; antennal fossae and ridges very prominent. Pronotum depressed, slightly convex, much broader than long; submarginal depressions prominent, calloused, principally behind eyes. Scutellum large; longer than pronotum;

nearly flat, apex very acute. Tegmina elongate; convex, with prominent undulations and callosities; sides subparallel; apex obtusely pointed; venation almost completely obsolete. Wings with venation as in *Leocomia* Ball. Middle tibiae rather short; first marginal spine short and strong, on basal third; second marginal spine long and sharp, on apical two-thirds.

Male genitalia about as in *Leocomia* Ball. Pygofer about as wide as long, roughly triangular in shape; aedeagus large, membranous, with a pair of small sclerotized appendages.

Genotype: *Asprocranites variegata* sp. n.

Asprocranites variegata sp. n. (fig. 9, G to M)

1923. *Philaenus fusco-varius* Wolcott, *J. Dept. Agr. P. R.* **7:** 257.
1929. *Philaenus fusco varius* Osborn, *J. Dept. Agr. P. R.* **13:** 91.
1933. *Philaenus fusco-varius* Leonard, *J. Dept. Agr. P. R.* **17:** 123.
1935. *Philaenus fusco-varius* Osborn, Sci. Surv. Porto Rico and Virgin Islands. **14:** 127.
1936. *Philaenus fusco-varius* Wolcott, *J. Agr. Univ. P. R.* **20:** 75.
1950. *Philaenus fusco-varius* Wolcott, *J. Agr. Univ. P. R.* **32:** 104.

This is a small, elongate, depressed species which may be easily recognized by the variegated coloration and dense pubescence.

Crown about twice as broad as long; anterior margin angularly curved and carinate; entire surface uneven, calloused, with stiff, spinelike hairs; ocelli large, inclined, closer to each other than to eyes, separated from hind border of crown by a distance about equivalent to their own diameter; eyes oval in dorsal aspect; face tumid; postclypeus longer than broad, entire surface covered with long pile. Pronotum much depressed; slightly convex; about half as long as wide; surface rugulose, beset with short, stiff, erect hairs and finer pubescence; submarginal depressions very prominent, calloused, particularly behind eyes; anterior margin evenly rounded; anterolateral margins long, oblique, carinate; humeri prominent; posterolateral margins sinuous, feebly carinate. Scutellum almost flat, about one and one-third times longer than pronotum. Tegmina densely covered with silken pubescence; claval suture forming a very deep furrow. Wings much broader than long, densely pilose; venation strong.

Male pygofer, in lateral view, about as long as wide, triangular in shape, posterior angle lobate; sternal plate proportionately large, rather broad, scooplike; styles shaped like in *Leocomia* Ball but comparatively much more prominent; aedeagus very large, fibrous, amorphous, with a chitinized, elongate median structure and two spinelike sclerotized hooks basally.

General color grayish brown variegated with dark brown, light yellowish and black. Whole body covered with golden pubescence; head with irregular black markings between ocelli and eyes; postclypeus with a large black median spot on superior border and a broad transverse black band across middle; anteclypeus with a dark brown or black spot at base which often coalesces with transverse band on postclypeus; basal joint of antennae black; eyes with central portion infuscated. Pronotum with a broad, curved transverse yellowish band on apical third, generally becoming darker toward posterior border; submarginal depressions behind eyes fusco-piceous. Scutellum light yellowish, with a transverse darker band across middle. Tegmina variegated with darker brown, with an irregular light yellowish fascia on basal third, a crescent-shaped similar fascia on clavus, a little before middle, and numerous small yellowish or ochraceous irregular spots on subterminal portion. Wings smoky hyaline, covered with dense brown pubescence; veins dark brown. Legs strongly marked with black. Venter dark fuscous.

Length to tip of tegmina, ♂: 3.74 mm., ♀: 3.78 mm.; width across humerals, ♂: 1.48 mm., ♀: 1.55 mm.

Holotype ♂: Maricao State Forest, P. R.; 27 November 1952; on *Rubus rosaefolius* Smith; J. A. Ramos.

Allotype ♀: Same data.

Paratypes: 1 ♂: Indiera Alta, Maricao, P. R.; 12 September 1946; J. A. Ramos; 2 ♂♂: Carite Mts., P. R.; 2 October 1947; J. S. Caldwell and L. F. Martorell; 1♂: Maricao State Forest, P. R.; 13 November 1947; J. S. Caldwell and L. F. Martorell; 2 ♂♂: El Yunque, P. R.; 12 December 1947 J. S. Caldwell and L. F. Martorell; 3 ♂♂: same locality; December 1951; J. Maldonado Capriles; 1 ♀: Maricao P. R.; 8 February 1936; on *Rubus rosaefolius* Smith; J. A. Ramos; 3 ♀♀: Mayaguez, P. R.; 19 August 1945; J. A. Ramos; 1 ♀: El Yunque, P. R. 4 April 1947; J. A. Ramos; 3 ♀♀: Carite Mts., P. R.; 2 October; 1947; J. S. Caldwell and L. R. Martorell; 2 ♀♀: El Yunque, P. R.; 12 December 1947; J. S. Caldwell and L. F. Martorell; 1 ♀: same locality; December 1951; J. Maldonado Capriles.

This is apparently the second most abundant cercopid in Puerto Rico. It occurs commonly throughout the interior of the island but it may be found also in the lowlands. The species usually breeds on the wild mountain mulberry, *Rubus rosaefolius* Smith. Wolcott (1950: 104) reports it also from several other food plants, including coffee and *Jambos Jambos* (L.) Millsp.

The species has been repeatedly reported from Puerto Rico by various authors under the name *Philaenus fusco-varius* Stal, a different Central American cercopid. All these records should thus be referred to *Asprocranites variegata* sp. n.

Gaetopsis gen. n.

Superficially resembling *Gaeta* Metcalf and Bruner in general appearance but stouter and much larger in form. The anterior margin of the head is more angulate and the face is not flat but swollen. The pronotum is more convex. The tegmina are proportionately longer and narrower, slightly tapering on terminal half; the venation is different and the veins more prominent.

General form robust. Head, including eyes, narrower than pronotum; crown rather short, flat, declivous, anterior margin angulately rounded, raised and carinate; ocelli prominent, closer to each other than to eyes; eyes roughly ellipsoidal in outline; face swollen, postclypeus distinctly longer than wide, not surpassing frontal coxae, rostrum very long, reaching hind femora. Pronotum broad, declivous on anterior two-thrids where it is also rugulose and sulcate along median line; posterior third slightly sloping backward; submarginal depressions distinct; posterior border deeply emarginate. Scutellum longer than pronotum; apex very acute. Tegmina long, narrow, terminal half gradually tapering apically, apex rounded; venation about as in *Aphrophora* Germar but with third anal vein obsolete. Wings with venation resembling that of *Leocomia* Ball. Middle tibiae comparatively short; first marginal spine very short and weak, obsolescent; second strong and prominent.

Male pygofer slightly longer than broad; sternal plate and styles somewhat reduced; aedeagus consisting of a long coiled, membranous tube ending in an acute spinous process, without median appendages.

Genotype: *Gaetopsis juanalis* sp. n.

Gaetopsis juanalis sp. n. (fig. 10, A to F).

A medium-large, robust, variegated, fuscous species with the entire body covered with golden pubescence and with irregular whitish spots on the tegmina.

Head moderately short, thick; crown punctulate, pilose; ocelli large, lying very near hind margin of crown; postclypeus very flat on disc. Pronotum twice as broad as long, entire surface thickly covered with long, apressed pile; anterior border curved; anterolateral margins moderately long, carinate. Scutellum about one and one-half times as long as pronotum. Tegmina with entire surface strongly pubescent. Wings long and broad, very hairy; venation conspicuous. Legs rather short, pilose; middle tibiae with second marginal spine placed a little beyond middle.

Male pygofer, in lateral view, a little longer than wide; ventral margin evenly rounded; dorsal margin nearly straight; posterior angle lobate; sternal plate widest near base, tapering to an obtuse apex; ventral margin

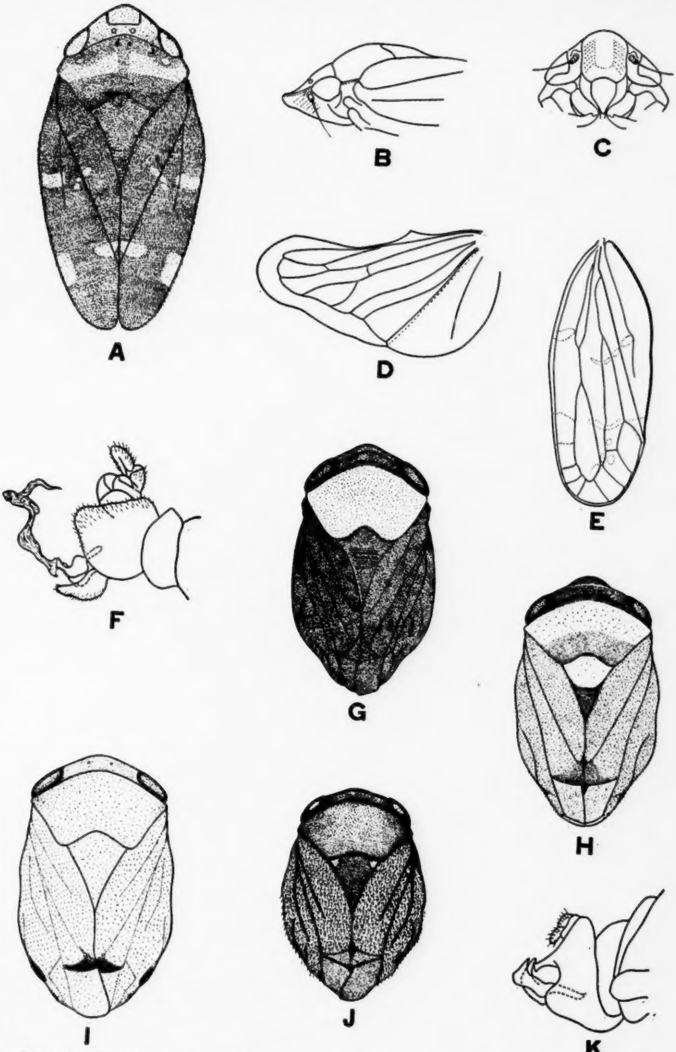

FIG. 10.—A, *Gaetopsis juanalis* sp. n., dorsal view. B, *G. juanalis* sp. n., lateral view of head and thorax. C, *G. juanalis* sp. n., frontal view. D, *G. juanalis* sp. n., wing. E, *G. juanalis* sp. n., tegmen. F, *G. juanalis* sp. n., lateral view of male genitalia. G, *Clastoptera flavidorsa* Metcalf and Bruner, dorsal view. H, *C. signifera* (Walker), dorsal view. I, *C. martorelli* sp. n., dorsal view. J, *C. diminuata* sp. n., dorsal view. K, *C. diminuata* sp. n., lateral view of male genitalia.

curved; dorsal margin sinuate; styles very broad near middle, terminal portion curved upward, preapically constricted, apex enlarged, blunt; aedeagus membranous, tubular, much enlarged, ending in an acute, fibrous structure.

General color dark fuscous. Head and anterior two-thirds of pronotum yellowish brown, becoming darker on anterior portion of pronotum; eyes chocolate brown. Tegmina with a clear spot at apex of basal third of costal area, a similar and larger spot about one-third from apex, another at tip of clavus, smaller and irregular spots on anteapical region, and one on middle of corium across to clavus. Entire pubescence golden yellow except on clear spots of tegmina where it is yellowish white. Wings transparent; veins dark brown.

Length to tip of tegmina, ♂: 7.41 mm.; width across shoulders, ♂: 2.99 mm.

Holotype ♂: Doña Juana Forest, P. R.; 10 August 1947; J. Maldonado Capriles.

Clastoptera Germar

This genus includes a large number of species. They are small, robust, globose insects. They may be easily recognized by having the apex of the clavus broadly rounded instead of pointed as in most cercopids.

General form robust, globose. Head considerably wider than long; crown very narrow, sloping; anterior margin rounded; ocelli distinct, usually placed about equidistant from posterior margin of frontoclypeus and posterior margin of vertex; eyes very broad, lying on same plane of crown; face inflated, ecarinate, lateral striations rather weak; antennal cavities deep, porminent. Pronotum convex, broader than long; anterior margin broadly rounded; lateral margins divergent; posterior margin deeply emarginate. Scutellum triangular, convex, deflected posteriorly. Tegmina short, broad, convex, pubescent, deflexed posteriorly, overlapping apically; clavus broadly rounded at apex; corium terminating in a more or less hyaline membrane with a conspicuous callose spot near apex. Middle tibiae with a single terminal row of spines. Ovipositors and male genital segments usually bent dorsad.

Genotype: *Clastoptera achatina* Germar (**1839:** 187), described from North America.

Clastoptera signifera (Walker) (fig. 10, H)

1851. *Lepyronia? signifera* Walker. List Homoptera British Mus. **3:** 728.

1859. *Lepyronia? signifera* Dohrn, Cat. Hemip. **1859:** 69.

1862. *Clastoptera brevis* Stal, *Ofb. Svenska Vet. Akad. Förh.* **19:** 494.

1895. *Clastoptera brevis* Goding, Bull. Ill. St. Lab. Nat. Hist. **3:** 501.
1912. *Clastoptera brevis* Lallemand, *Gen. Insect.* **143:** 23.
1935. *Clastoptera brevis* Osborn, Sci. Surv. Porto Rico and Virgin Islands. **14:** 128.
1936. *Clastoptera brevis* Wolcott, J. *Agr. Univ. P. R.* **20:** 75.

A small shining, dark fuscous species with light-brown tegmina and two broad, bright yellow transverse bands on the back separated by a band of pale reddish brown.

Form short and compact, about twice as long as broad. Head, with eyes, somewhat narrower than pronotum; crown moderately short, a little over three and a half times as wide as long; anterior margin broadly rounded at extreme apex where it is also distinctly protuberant; vertex shallowly depressed transversely; anterior carina very strong, following curvature of posterior border; frontoclypeus about as long as vertex, very prominent from above; ocelli conspicuous, nearly equidistant from each other and from eyes; postclypeus much inflated, very convex dorsad. Pronotum rather strongly convex, smooth, transverse striae indistinct, about twice as broad as long medianly. Scutellum large, about one and one-fourth as long as pronotum along median line. Tegmina semitransparent, apex of clavus opaque; callus small, circular; corium densely covered with strong, moderately long hairs; membrane denudate.

Entire head and narrow anterior border of pronotum shining brownish black; anterior portion of pronotum and basal half of scutellum pale peach yellow; posterior third of pronotum reddish brown; terminal half of scutellum dark fuscous. Tegmina light brown, darker at apex of clavus and on callus; callus anteriorly bordered with yellowish white. Wings transparent; veins dark brown. Legs pale yellow, marked with brown. Venter fuscous.

Length to tip of tegmina, ♀: 2.95 mm.; width across shoulders, ♀: 1.55 mm.

This species was originally described from Puerto Rico by Walker (1851: 728). Stal (1862b: 494) and Lallemand (1912: 23) considered it to be *C. brevis* (Walker), which, in the opinion of the writer, is an entirely different South American species.

J. Maldonado Capriles found this insect breeding on the fern *Acrostichum aureum* L. at Ponce, P. R.; 2 April 1946.

Clastoptera flavidorsa Metcalf and Bruner (fig. 10, G)

1925. *Clastoptera flavidorsa* Metcalf and Bruner, *Psyche* **32:** 104.

This is a small beautiful species which may be very easily identified by the contrasting yellow and black color.

Form short and broad. Head rather short; crown with anterior margin following nearly same curvature of posterior border; transverse carina on front margin of vertex prominent; posterior border of vertex well raised into a strong ridge. Pronotum convex, smooth; about twice as broad as long; broadly curved anteriorly. Scutellum large, about one and one-fourth times as long as pronotum on median line. Tegmina opaque, except for a small elongate hyaline area anterior to callus. Wings short and broad. Legs short and stout.

General color piceous; tarsi whitish. Entire pronotum, except narrow anterior border, light greenish-yellow. Scutellum sometimes with basal portion concolorous with pronotum.

This species was originally described from Cuba (Metcalf and Bruner 1925: 104). It is apparently not common in Puerto Rico, where it seems to be restricted to the mountains of the interior of the island. The following are the specimens at hand:

1 ♀ : Maricao, P. R.; 15 January 1930; S. T. Danforth; 1 ♀ : Consumo, P. R.; 12 October 1937; J. A. Ramos; 1 ♀ : Aibonito, P. R.; 30 November 1947; J. S. Caldwell and L. F. Martorell; 1 ♀ : Maricao State Forest, P. R.; 27 November 1952; J. A. Ramos.

Clastoptera martorelli sp. n. (fig. 10, I)

This is a rather small, smooth, shining species of a uniform fulvous color and semitransparent tegmina.

General body form as in *C. flavidorsa* Metcalf and Bruner. Head about as broad as pronotum; crown with anterior margin following same contour of anterior pronotal border, strongly sloping downward; transverse depression on vertex somewhat weaker between ocelli; transverse carina on anterior border of vertex very weak; ocelli large, midway between anterior and posterior margins of vertex; frontoclypeus visible from above; postclypeus tending to flatten distally. Pronotum very smooth, convex; twice as broad as long on median line; anterior border strongly curved; lateral margins sinuate; posterior margin obtusely and deeply emarginate. Scutellum moderately large, slightly longer than pronotum along median line; somewhat flattened on basal two-thirds; apex very acute. Tegmina subhyaline, pubescent only on clavus and veins of corium; callus very strongly elevated, circular, small. Legs short and strong.

Uniformly fulvous in color. Eyes reddish; face transversely infuscated at level of lower margin of eyes. Tegmina yellowish-hyaline; callus and apex of clavus contrastingly reddish-brown.

Length to tip of tegmina, ♀ : 3.11 mm.; width across humeri, ♀ : 1.62 mm.

Holotype ♀ : El Yunque, P. R.; 22 August 1947; J. S. Caldwell and L. F. Martorell.

Paratypes: 1 ♀: Toro Negro Mts., P. R.; 14 November 1947; J. S. Caldwell and L. F. Martorell.

The writer takes great pleasure in naming this species after his friend and colleague, Dr. Luis F. Martorell, Entomologist at the Agricultural Experiment Station of the University of Puerto Rico, in acknowledgment of his assistance and cooperation in the preparation of this paper.

Clastoptera diminuata n. sp. (fig. 10, J and K)

A very small, short, broad and compact species of a polished, pitch black color.

General form of the body short and very broad, about one and one-half times as long as broad. Head as broad as pronotum; crown very steep, broadly rounded anteriorly; ocelli closer to each other than to eyes; frontoclypeus nearly concealed from above. Pronotum very smooth and polished, convex; about twice as broad as long on median line; posterior margin very shallowly emarginate. Scutellum large, slightly longer than pronotum; basal portion somewhat depressed; apex acute. Tegmina short and very broad, strongly opaque; entire corium, including clavus, with minute but conspicuous punctures, each puncture bearing a very long hair; veins clearly raised; callus comparatively very large and prominent, extending anteriorly along costa for a short distance; apex of clavus not thickened. Hind legs very strong, and robust.

Male pygofer very short and broad; posterior border with a median elongate process; lower hind angle broadly lobate; sternal plate very small, scoop-like; styles prominent, with a stout, spine-like process apically on dorsal margin; aedeagus much reduced, concealed.

General color shining black. Eyes dark vinaceous; extreme lower side of head whitish; outer angles of scutellum greenish white; anterior border of callus milky greenish white, becoming hyaline anteriorly along costal margin of tegmina. Front and middle legs light yellow with a greenish tinge; tibiae banded with dark fuscous. Hind legs fusco-piceous; apices of tibiae and tarsi whitish.

Length to tip of tegmina, ♂: 2.26 mm.; width across humeri, ♂: 1.33 mm.

Holotype ♂: Guilarte, P. R.; 7 February 1954; J. Maldonado Capriles.

Family Membracidae

Most membracids are easily distinguished from the other Homoptera by the peculiar structure of the pronotum which usually exhibits a curious and grotesque appearance. It is much enlarged, elevated, or hood-like in shape, with or without processes in the form of crests, horns, tubercles or gibbosities. The scutellum is generally partially or totally concealed by the posterior prolongation of the pronotum or it may be fully exposed when such prolongation is absent.

KEY TO THE GENERA AND SPECIES OF PUERTO RICAN MEMBRACIDAE

1. Pronotum without a posterior process, scutellum entirely exposed....2
1. Pronotum extended into a posterior process, scutellum partially or totally concealed....3
2. Base of head bicornute, suprahumerals extended into horns *Antillotolania doramariae* sp. n.
2. Base of head simple, no suprahumeral horns..*Deiroderes inermis* sp. n.
3. Scutellum partially exposed at sides of posterior pronotal process....4
3. Scutellum completely concealed by posterior pronotal process......6
4. Posterior process reaching only to inner angle of tegmina, pronotum strongly punctate, tegmina opaque on proximal half *Brachycentrotus rufinervis* sp. n.
4. Posterior pronotal process surpassing inner angle of tegmina, pronotum smoother, tegmina narrowly opaque at base..Genus *Monobelus* Stal..5
5. Tegmina with two discoidal cells, pronotum uniformly colored *M. fasciatus* (Fabricius)
5. Tegmina with one discoidal cell, pronotum bicolored *M. maldonadoi* sp. n.
6. At least first two pairs of tibiae foliaceous....7
6. All tibiae simple, not foliaceous....8
7. Form globular, pronotum corrugated and tubercled, hind tibiae not foliaceous....*Bolbonota melaena* (Germar)
7. Form alongate, pronotum with two dorsal, obtuse horns, hind tibiae also foliaceous....*Jibarita borincana* sp. n.
8. Median apical cell of tegmina stylate, its base not truncate *Micrutalis calva* (Say)
8. Median apical cell of tegmina sessile, its base truncate....9
9. Pronotum produced anteriorly into a porrect, sulcate horn Genus *Nessorhinus* Amyot and Serville..10
9. Pronotum not produced anteriorly into a horn....12
10. Dorsum of pronotum elevated into a spinelike median dorsal horn, humerals spinous....*N. graciloides* Dozier
10. Dorsum of pronotum not elevated into a spinelike median dorsal horn, humerals short, not spinous....11
11. Dorsum of pronotum elevated into a low broad gibbosity, form stout *N. gibberulus* Stal

11. Dorsum of pronotum straight, form slender........*N. esbeltus* sp. n.
12. Posterior pronotal process spatulate, apex tridentate
Spathenotus tridentatus sp. n.
12. Posterior pronotal process slender, apex pointed or rounded.......13
13. Dorsum of pronotum with a spinelike median dorsal process, humeral angles spinous...................*Spinodarnoides typus* Funkhouser
13. Dorsum of pronotum straight, humerals not spinous..............14
14. Pronotum strongly punctate, posterior pronotal process surpassing inner angle of tegmina, size over 4.50 mm
Paradarnoides caldwelli sp. n.
14. Pronotum punctulate, posterior pronotal process reaching only to inner angle of tegmina, size about 3.00 mm
Brachytalis punctulatus sp. n.

Subfamily Membracinae

The members of this subfamily may be readily recognized by having at least the fore and middle legs with the tibiae foliaceous or much flattened. The venation of the tegmina is sometimes reduced or obscured. The subfamily is abundantly represented in the Neotropical Region where many of the species are most bizarre and grotesque in appearance.

Jibarita gen. n.

A genus of small elongate membracids with the pronotum conspicuously marked with large, strong punctures and elevated into two prominent dorsal processes. In the female the two dorsal processes of the pronotum are considerably less pronounced.

Head, across eyes, much narrower than pronotum; face strongly deflexed caudad, longer than wide; ocelli prominent, closer to eyes than to each other and lying well above a line connecting center of eyes; clypeus large, about half as long as entire face; eyes prominent. Pronotum strongly raised, lowered behind eyes to form prominent postocular lobes; humeral angles short, obtuse; posterior process wide, elongate, extending to apex of tegmina; entire surface heavily punctate, with a well defined median carina; dorsum with two large processes. Tegmina not free; strongly coriaceous and punctate; venation obsolescent, reticulate on apex; apical limbus broad. Wings with four apical cells. Legs with tibiae much dilated, especially front ones.

Female with anterior dorsal process of pronotum less conspicuous, directed anteriorly and upward, crest-like; posterior dorsal process very low, obsolescent.

Genotype: *Jibarita borincana* sp. n.

Jibarita borincana sp. n. (fig. 11)

A small densely punctate species of a general testaceous color.

Head a little wider than long; face rugose-punctate, covered with scattered pile; basal margin convex; ocular margins vertical; lower margins of genae prominent, foliaceous; clypeus very large, base angular, lateral margins rounded, foliaceous, apical margin nearly straight. Pronotum uniformly and densely covered with large, deep, pit-like punctures which impart to it a lacelike appearance, principally on posterior process; median carina obscure on terminal half of posterior process; anterior dorsal process about as high as long, longer than broad, its base deeply constricted on each side; posterior dorsal process humplike, with a conspicuous depression on each side. Tegmina wholly opaque; entire surface densely punctate, each puncture with a short, stiff hair. Sides and ventral parts of thorax punctate and tomentose. Legs with femora pilose; tibiae much dilated, strongly punctate on outer surface, pilose and with heavy denticles on margins. Venter pubescent.

Male pygofer long and broad, sides narrowing ventrad; lateral valves prominent, posterior margin broadly and shallowly emarginate, apex broad, obtusely rounded; sternal plate elongate, narrow, terminal half strongly curved upward, apex broadly rounded; in ventral aspect, about three times as long as wide at base, narrowing gradually to apex which is slightly widened, rounded and divided by a short incision; styles comparatively small, very slender, curved, with a small obtuse anteapical spine on dorsal margin; aedeagus with anterior arm as long as posterior arm but stouter, posterior arm elongate, attenuated to an obtuse point.

General color uniform pale testaceous, very slightly darker on head and on sides and ventral parts of thorax. Posterior dorsal process of pronotum slightly fuscous at sides. Wings yellow hyaline; veins reddish brown. Denticles on tibiae dark brown.

Length, front of pronotum to apex of tegmina, ♂: 3.33 mm., ♀: 3.66 mm.,; width across humeral angles, ♂: 1.30 mm., ♀: 1.43 mm.

Holotype ♂: Aguas Buenas, P. R.; 14 October 1947; J. S. Caldwell and L. F. Martorell.

Allotype ♀: Same data.

Paratypes: 1 ♂: same data; 1 ♀: Same data.

Bolbonota Amyot and Serville

1843. *Bolbonota* Amyot and Serville, Hemiptères. **1843:** 537.

The members of this genus may be readily recognized by the small size, globular form and the wrinkled, corrugated appearance of the pronotum.

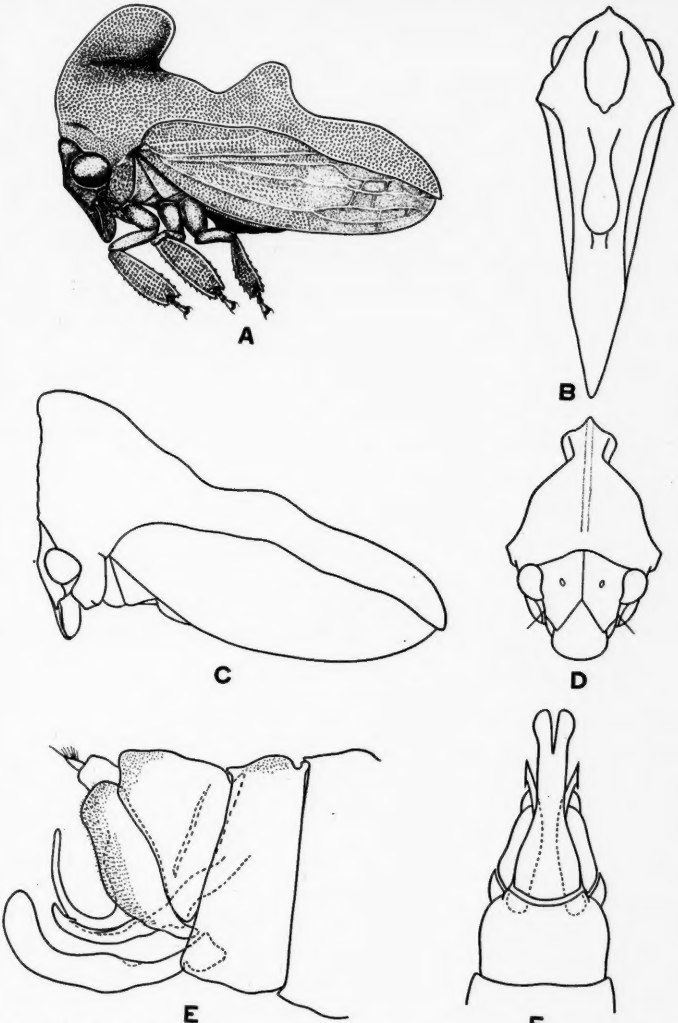

FIG. 11.—A, *Jibarita borincana* sp. n., lateral view of male. B, *J. borincana* sp. n., dorsal outline of male. C, *J. borincana* sp. n., lateral outline of female. D, *J. borincana* sp. n., frontal view of male. E, *J. borincana* sp. n., lateral view of male genitalia. F, *J. borincana* sp. n., ventral view of male genitalia.

Face longer than wide, somewhat flattened, superior margin arched; ocelli closer to eyes than to each other; clypeus comparatively large lower margin angulate, extending below lower margins of genae for a distance. Pronotum with metopidium steep; humeral angles rounded, broad, prominent; posterior process very wide; entire surface very rough, wrinkled, tuberculate. Tegmina with two discoidal cells. Fore and middle tibiae broadly dilated.

Genotype: *Membracis nisus* Germar (1835: 229)

Bolbonota melaena (Germar) (fig. 12, A to C).

1835. *Membracis melaena* Germar, *Rev. Ent. Silbermann* **3:** 299.

An entirely dark fuscous species with inconspicuous small dots on corium and apex of tegmina yellowish-hyaline.

The record for this species is based on a single female specimen in the U. S. National Museum collected at Toa Alta, P. R., September 6, 1921 by G. N. Wolcott. This specimen was determined to belong to this species by W. D. Funkhouser.

Subfamily Darninae

In this subfamily the median apical cell of the tegmina is sessile, with the base truncate and never stylate. The tibiae are simple and the lower margins of the head are not thin or foliaceous. The scutellum is completely concealed by the posterior process of the pronotum. This is the largest subfamily of the Puerto Rican membracid fauna.

Nessorhinus Amyot and Serville

1843. *Nessorhinus* Amyot and Serville, Hemiptères, **1843:** 542.

This genus may be readily recognized by the prominent porrect prolongation of the pronotum in front of the head.

Head very small, nearly concealed from above by anterior process of pronotum; width across eyes considerably less than width of pronotum; face short and broad, strongly inclined in profile; eyes large, prominent, strongly protuding; ocelli placed high on face, very close to eyes and to upper margin. Pronotum, in lateral view, nearly straight, strongly arched or with a variable median dorsal elevation; anterior process long, straight, or slightly curved in profile, broad or tapering to an obtuse point, basal portion entire, apical remainder consisting of two closely contiguous carinate processes with a sulcus between them both dorsally and ventrally; metopidium moderately declivous; humeral angles broadly pointed or developed into spinelike lateral horns; posterior process elongate, slender, slightly constricted near middle, extending to tip of tegmina or nearly so; sides deflexed, margins carinate; dorsum tricarinate, median carina per-

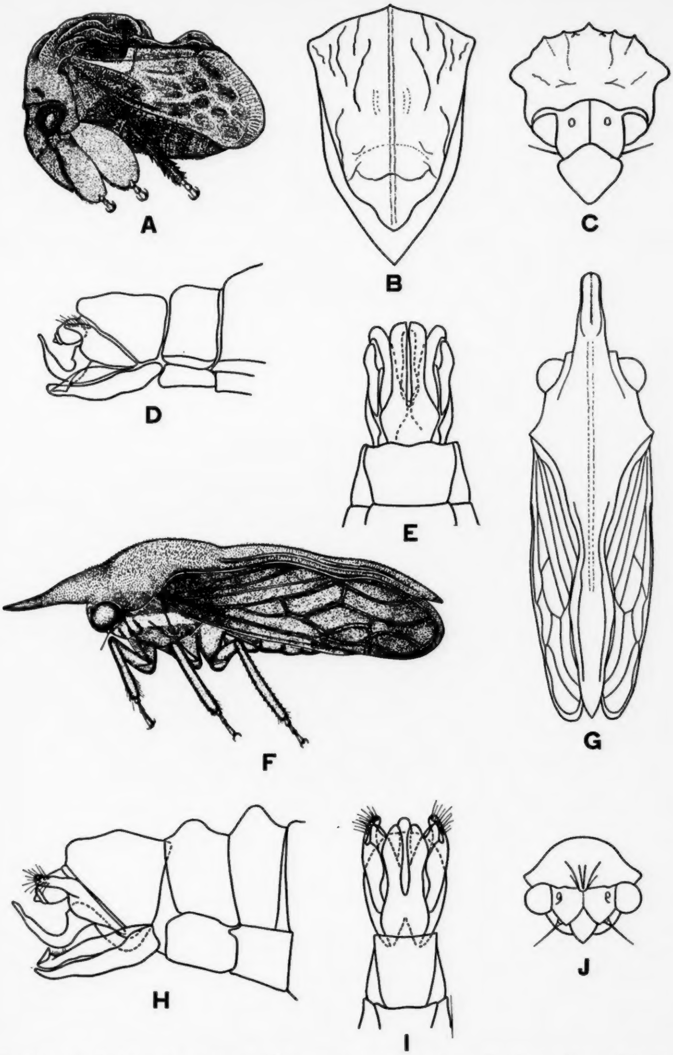

FIG. 12.—A, *Bolbonota melaena* (Germar), lateral view. B, *B. melaena* (Germar), dorsal outline. C, *B. melaena* (Germar), frontal view. D, *Nessorhinus gibberulus* Stal, lateral view of male genitalia. E, *N. gibberulus* Stal, ventral view of male genitalia. F, *N. esbeltus* sp. n., lateral view. E, *N. esbeltus* sp. n., dorsal outline. H, *N. esbeltus* sp. n., lateral view of male genitalia. J, *N. esbeltus* sp. n., ventral view of male genitalia. J, *N. esbeltus* sp. n., frontal view.

current to base of anterior process. Tegmina slightly concealed by sides of posterior pronotal process, long, moderately narrow; veins prominent; corium with five apical cells, fourth and fifth curved; usually three discoidal cells; apical limbus narrow.

Genotype: *Nessorhinus vulpes* **Amyot and Serville (1843a: 542) described from Hispaniola.**

Nessorhinus gibberulus Stal (fig. 12, D and E)

1869. *Nessorhinus gibberulus* Stal, *Ofv. Svenska Akad. Förh.* **1869:** 294.

1927. *Nessorhinus gibberulus* Funkhouser, *Gen. Cat. Hemiptera Fasc.* **1:** 150.

1931. *Nessorhinus gibberulus* Dozier, *American Mus. Nov.* **510:** 3.

1935. *Nessorhinus gibberulus* Osborn, *Sci. Surv. Porto Rico and Virgin Islands* **14:** 124–5.

1936. *Nessorhinus gibberulus* Wolcott, *J. Agr. Univ. P. R.* **20:** 72.

1950. *Nessorhinus gibberulus* Wolcott, *J. Agr. Univ. P. R.* **32:** 104.

1951. *Nessorhinus gibberulus* Funkhouser, *Gen. Insect. Homoptera. Membracidae. Fasc.* **208:** 89.

This species differs from the other known species of the genus, except *N. esbeltus* sp. n., in lacking the pronounced dorsal crest or median horn on the pronotum and in not having the humeral angles produced into horns. From *N. esbeltus* sp. n. it differs in being stouter, more gibbous, and in the different male genitalia.

Head very short, broad, deflexed; entire face densely pilose. Pronotum, in profile, strongly arched dorsally, slightly gibbous at base of posterior process; anterior process moderately long, straight, inclined downward, margins conspicuously carinate; humeral angles prominent, short, not produced into horns; posterior process with five carinae, marginal ones running from humeri to apex; median carina running from base of anterior process to apex; entire pronotum conspicuously punctate and covered with short hairs which form solid patches on sides of posterior process; punctures on metopidium forming transverse rugae. Ventral parts and sides of thorax covered with short pile, denser behind eyes and below humeri where it forms a solid coat which is very prominent. Tegmina membranous, base coriaceous; veins very strong, with short inclined hairs. Legs completely covered with short pubescence; hind tibiae longer and thinner than front and middle tibiae. Entire venter covered with hairs, somewhat rugose.

Male pygofer, in lateral aspect, with dorsal margin nearly straight; lateral valves with superior angle prolonged into a spinelike process narrowed to an obtuse point and directed straight backward; sternal plate, in ventral view, about twice as long as wide, broadened near base, then abruptly narrowed, sides of narrower portion almost parallel, apex evenly rounded, medianly incised nearly to region of greatest width; in lateral view medianly with dorsal and ventral margins sinuate, widest near base, apex broadly rounded; styles long and narrow, terminal portion abruptly twisted outward, apex truncate; aedeagus with posterior arm enlarge basally, rather abruptly attenuated distally, anterior arm subequal in size to posterior arm, broad at base.

General color dark fuscous with whitish pubescence. Head fuscous black; ocelli and eyes yellowish brown. Pronotum with a black blotch behind eyes; posterior process with several irregular small patches of white or yellowish pubescence along sides; sides of thorax with a broad band of white or yellowish-white behind eyes; ventral parts of thorax almost black. Tegmina yellowish-hyaline, dark brown at base, a lighter small area distad of this; veins fuscous, darker on apical half of costal cell; corium sometimes with fuscous black markings at base of anteapical cells, base of apical cells and tip of limbus. Wings milky hyaline; veins light brown. Legs fusco-ferrugineous; tibiae testaceous. Venter dark fuscous or fuscous black.

Length, apex of anterior pronotal process to apex of tegmina, ♂: 6.10 mm., ♀ : 7.34 mm.; width across humeri, ♂: 2.00 mm., ♀ : 2.60 mm.

This is apparently the most abundant membracid in Puerto Rico. It ranges all over the Island as is evident from the extensive collection at hand. Wolcott (1950: 104) records this species from cotton and coffee and states that it does not show any clearly defined host preference since it has been collected also on several trees and many other plants.

The record of *N. vulpes* Amyot and Serville given by Osborn, (1935: 125-6), based on specimens in the U. S. National Museum determined by W. D. Funkhouser, should be referred to this species. These specimens were examined by the writer and found to be typical *N. gibberulus* Stal, as they lack the dorsal crest on the pronotum and the humeral horns which characterize the first species.

Nessorhinus graciloides Dozier

1931. *Nessorhinus graciloides* Dozier, *Amer. Mus. Nov.* **510:** 3.
1935. *Nessorhinus graciloides* Osborn, *Sci. Surv. Porto Rico and Virgin Islands* **14:** 125.
1936. *Nessorhinus graciloides* Wolcott, *J. Agr. Univ. P. R.* **20:** 74.
1950. *Nessorhinus graciloides* Wolcott, *J. Agr. Univ. P. R.* **32:** 104.
1951. *Nessorhinus graciloides* Funkhouser, *Gen. Insect. Homoptera Membracidae. Fasc.* **208:** 89.

This species is very similar to *N. gracilis* Metcalf and Bruner and to *N. vulpes* Amyot and Serville in that it also possesses a dorsal horn on the pronotum and the humeral angles are produced into horns. It differs from both these species in the shorter and differently shaped dorsal process and in the distinctly shorter humeral angles. There are also minor differences in coloration in the three species.

Since this species has not been seen by the writer, the following description is taken from the original one.

Anterior process rather short, strongly deflexed, distinctly narrowing to apex, with two longitudinal lateral carinae, decidedly closer to lateral margins than to each other; pronotum densely punctate; lateral processes or horns very short, distinctly turned; dorsal process compressed, comparatively short, subacute at tip, sides sloping downward, reminding one of a mountain peak; posterior process elongate, slender, following contour of tegmina but distinctly shorter than latter.

General color dark brown-black, covered very lightly with inconspicuous grayish hairs; clumps of grayish white hairs form a distinct whitish stripe along lower side of thorax and four whitish spots along posterior process, apical spot being smaller than others. Tegmina semi-opaque, fuscous black; veins paler. Legs and eyes reddish testaceous. Venter fuscous.

Length, apex of anterior process of pronotum to apex of tegmina, ♂: 7.00 mm.; width across lateral processes, ♂: 2.80 mm.

Known only from the type, a male collected at Caguas, P. R., 25 May 1924, H. L. Dozier.

Nessorhinus esbeltus sp. n. (fig. 12, F to J)

This species is related to *N. gibberulus* Stal but differs substantially from it in being much narrower, not gibbous and in having different male genitalia.

Head extremely short, broad; face recumbent, densely pilose; ocelli closer to eyes than to base of head. Pronotum much flattened, slightly sloping on metopidium; anterior process as in *N. gibberulus* Stal but slightly longer and much narrower; humeral angles broadly pointed, not produced into spines; posterior process feebly tectiform, marginal carinae very thin, lateral carinae evident on terminal half only, median carina percurrent from base of anterior process to tip of posterior process; entire pronotum uniformly and densely punctate and covered with very short appressed hairs. Sides and ventral parts of thorax and venter with similar but much denser pubescence. Tegmina opaque; veins very heavy. Legs covered with scant pile.

Male pygofer, in profile, with dorsal margin slightly raised at middle, long and broad; lateral valves with superior angle produced into a prominent, elongate process with a rounded end; sternal plate in ventral aspect about twice as long as wide, with a shallow but very wide constriction at middle, apex rather acutely rounded, a deep incision reaching a little beyond middle; in profile, both ventral and dorsal margins sinuate, widest at base, tip narrowed to a point; styles long and narrow, tip broadly rounded and bent forward and downward; aedeagus as in *N. gibberulus* Stal but with the posterior arm thinner at base and with the tip slightly broader, anterior arm smaller than posterior arm.

General color fusco-piceous to black, covered with yellowish pile above and whitish pile below; pubescence denser on face, sides and ventral portions of thorax. Eyes reddish brown. Tegmina yellowish brown, marked with black at base, costal cell, apex, and veins. Wings brownish-hyaline; veins dark brown. Legs yellowish ferrugineous; tarsi darker.

Length, apex of anterior process to tip of tegmina, ♂: 7.20 mm., ♀: 7.70 mm.; width across humeral angles, ♂: 2.10 mm., ♀: 2.30 mm.

Holotype ♂: El Yunque, P. R.; December 1951; J. Maldonado Capriles

Allotype ♀: Same data.

Paratypes: 1 ♂; Maricao State Forest, P. R.; 30 May 1938; J. A. Ramos; Matrullas, Villalba, P. R.; 11 October 1946; J. A. Ramos; 1 ♀: Carite Mts., P. R.; 2 October 1947; J. S. Caldwell and L. F. Martorell; 1 ♀: El Yunque, P. R.; 12 December 1947; J. S. Caldwell and L. F. Martorell.

Spinodarnoides Funkhouser

1930. *Spinodarnoides* Funkhouser, *J. N. Y. Ent. Soc.* **28:** 413.

This genus is characterized by the absence of an anterior prolongation of the pronotum, by the spinous humeral angles and the spine-like median dorsal process. The face has a transverse ridge with the base and lower surface at a slanting position from it when viewed laterally.

Head much broader than long; face with superior margin sinuate; ocelli prominent, much closer to eyes than to each other and lying just above transverse ridge; clypeus broad, extending for about two-thirds of its length below sinuate margins of genae. Pronotum low, convex; metopidium sloping; median carina strongly percurrent; humeral angles extended into long, sharp spines; dorsum with a short, sharp median horn; posterior process elongate, slender, pointed, tricarinate, tip not reaching apex of tegmina. Tegmina free, long and narrow, hyaline; five apical cells; three discoidal cells; apical limbus narrow.

Genotype: *Spinodarnoides typus* Funkhouser (**1930:** 413–4).

Spinodarnoides typus Funkhouser

1930. *Spinodarnoides typus* Funkhouser, *J. N. Y. Ent. Soc.* **28:** 413–4.
1933. *Spinodarnoides typus* Leonard, *J. Dept. Agr. P. R.* **17:** 37.
1936. *Spinodarnoides typus* Wolcott, *J. Agr. Univ. P. R.* **20:** 75.
1950. *Spinodarnoides typus* Wolcott, *J. Agr. Univ. P. R.* **32:** 106.

1951. *Spinodarnoides typus* Funkhouser, *Gen. Insect. Homoptera. Membracidae. Fasc.* **208:** 89–90.

This species is easily identified by the elongate, slender, punctate body; the spinous humeral angles and by the prominent spiniform horn on the pronotum. The head has a transverse ridge on the face from which the base and lower regions slope down.

Head punctate, pubescent, twice as wide as long; frontal angle sharp; base sinuate; ocelli prominent, more than twice as close to eyes than to each other, lying about on across middle of eyes; eyes large; clypeus twice as long as wide, protruding from inferior margin of genae for two-thirds of its length. Pronotum punctate, slightly tumentose; metopidium sloping, twice as wide as high; median carina percurrent; humeral angles developed into sharp spines; dorsum elevated into a strongly angular, blunt spine situated just back of humeral angles; posterior process elongate, slender, straight, tricarinate; apex not quite reaching tip of abdomen. Tegmina free, hyaline; base narrowly coriaceous and punctate; veins heavy. Sides of thorax tomentose.

General color brown. Legs yellow brown. Abdomen brown with yellow lateral margins.

Length, front of head to tip of tegmina, ♀ : 7.30 mm.; width across humeral spines, ♀ : 3.50 mm.

Known only from the type, a female in the Funkhouser collection in the University of Kentucky (Allen 1951: 486).

Paradarnoides Fowler

1894. *Paradarnoides* Fowler, *Trans. Ent. Soc. London.* **1894:** 422.

This genus resembles *Darnoides* Fairmaire but differs from it in possessing three discoidal cells in the tegmina and having the ocelli located very close to the eyes.

Head much deflexed, about half as long as wide; ocelli much closer to eyes than to each other; clypeus relatively large, projecting for more than half its length below lower borders of genae. Pronotum not elevated, convex, sculptured, with a percurrent median carina; base almost completely concealing head from above; humeral angles rather wide; no suprahumeral processes; posterior process long, slender, moderately tectiform, tip subacute and not quite reaching apex of tegmina. Tegmina free, subopaque, coriaceous and punctate near base; venation very strong; five elongate apical cells; three discoidal cells; apical limbus moderately narrow. Wings with four apical cells.

Genotype: *Paradarnoides severini* Fowler (**1894:** 422), described from Guadeloupe, Lesser Antilles.

Paradarnoides caldwelli sp. n. (fig. 13, A to D, and also F)

A medium size species easily separated from the other three species of the genus, *P. severini* Fowler, *P. ignipes* Fowler and *P. danforthi* Ramos, by the shape of the pronotum, which extends over the head in a hoodlike manner, and by the different coloration.

Face convex, clothed with moderately long pubescence; antennal ledges prominent; clypeus long and broad, projecting below lower borders of genae for nearly half its length into a prominent semicircular lobe; ocelli on upper corners of face, very close to eyes, with a conspicuous transverse ridge below. Pronotum convex; entire surface densely and strongly punctate, except for a smooth area behind eyes; median carina prominent, percurrent; anterior border strongly convex, extended over base of head; metopidium gently sloping; humeral angles short and broad; posterior process wide at base, elongate, narrowing to an obtuse apex, slightly tectiform, with two rather obsolete lateral carinae near middle, lateral margins carinate. Tegmina semiopaque; base coriaceous, punctate. Sides of thorax and entire undersurface densely pubescent. Legs moderately pilose, pilosity stronger on tibiae; metatibiae with a double row of close, short denticles.

Male pygofer a little longer than wide, as seen in profile, with sides narrowing ventrad and dorsal margin nearly straight, except on terminal third where it curves downward; lateral valves prominent, elongate, superior angle produced into a large spine-like process, posterior margin with a wide, short lobe; sternal plate elongate, wider at base, narrowing to a rounded apex, dorsal margin slightly deflexed outward before apex, ventrally slit by a median incision which reaches forward just before middle; styles elongate, wider at middle, ventral margin sinuate, dorsal margin irregular, terminal portion narrow, slender, reaching tips of sternal plate, then sharply bent forward into a hook; aedeagus with anterior arm shorter, much stouter, posterior arm longer, slightly curved in profile, attenuated into a fine sharp point bearing minute teeth.

General color yellowish fuscous. Head (except genae in female), smooth area on pronotum behind eyes, sides and ventral parts of thorax piceous.

Length, front of pronotum to tip of tegmina, ♂: 4.61 mm., ♀: 5.74 mm.; width across humeral angles, ♂: 1.85 mm., ♀: 2.07 mm.

Holotype ♂: Guánica State Forest, P. R.; 11 October 1947; J. A. Ramos.

Allotype ♀: Km. 13.5, Road 36 Ponce, P. R.; 5 October 1933; on *Tabebuia* sp.; R. G. Oakley (U. S. National Museum)

Paratypes: 1 ♂: Same locality as holotype; 4 October 1947; J. A. Ramos.

The writer takes great pleasure in naming this species in honor of J. S. Caldwell in recognition of his valuable contributions to our knowledge of the Puerto Rican homopterous fauna.

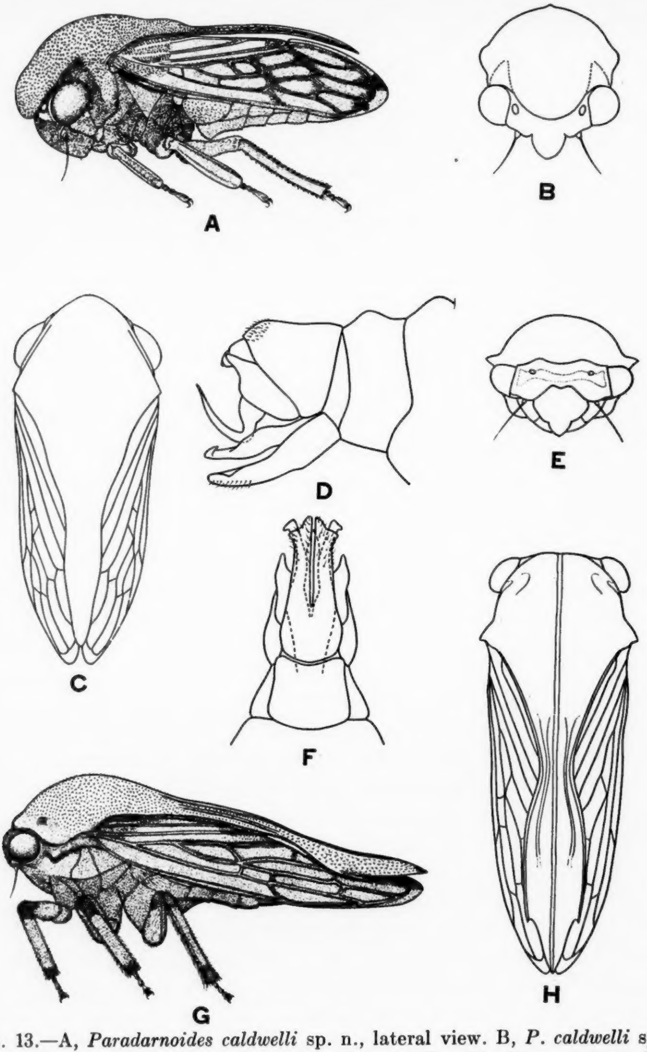

FIG. 13.—A, *Paradarnoides caldwelli* sp. n., lateral view. B, *P. caldwelli* sp. n., frontal view. C, *P. caldwelli* sp. n., dorsal outline. D, *P. caldwelli* sp. n., lateral view of male genitalia. E, *Spathenotus tridentatus* sp. n., frontal view. F, *P. caldwelli* sp. n., ventral view of male genitalia. G, *S. tridentatus* sp. n., lateral view. H, *S. tridentatus* sp. n., dorsal outline.

Spathenotus gen. n.

This genus may be easily identified by the low, moderately convex pronotum which is destitute of tubercles, horns, or any other processes, and by the greatly elongate, spatulate posterior pronotal process.

Head as wide as pronotum across humeri; face about twice as long as wide, upper margin nearly straight, carinate; base with a short sulcus at middle; ocular margins slightly slanting; lower borders of genae curved, ridged; entire surface smooth, with a wide transverse carina; ocelli lying just above this carina; clypeus longer than wide, strongly deflexed; eyes large, protuberant. Pronotum low, moderately convex; anterior border broadly rounded, antehumeral borders not projected into postocular lobes; humeral angles strong, prominent; posterior process elongate, tectiform, spatulate on terminal half, abruptly acuminate at apex, margins very strongly carinate except on terminal acumination; surface heavily punctate, pilose, with a median carina along entire length and two lateral ones only at middle. Tegmina much covered by sides of spatulate portion of posterior pronotal process, elongate, membranous, coriaceous at base, veins strong; five apical cells, all elongate; three anteapical cells; apical limbus broad. Wings with four apical cells.

Genotype: *Spathenotus tridentatus* sp. n.

Spathenotus tridentatus sp. n. (fig. 13, E, G, and H)

This is an elongate, ferrugineous species with prominent eyes and low, densely punctate pronotum. The apical margin of the posterior pronotal process is conspicuously tridentate.

Head short and broad, partly exposed in front of pronotum; lower portion of face strongly deflexed, densely pubescent. Pronotum, except large smooth area behind eyes, strongly punctate, somewhat rugose on metopidium which is very gently sloping, each puncture with a short, curved bristle; humeral angles nearly auriculate; apex of posterior process tridentate, median tooth larger, lateral teeth much reduced. Tegmina membranous, base opaque and punctate; venation strong. Entire undersurface clothed with smooth pubescence which is weaker on venter. Legs densely pilose, metatibiae with a double row of small inconspicuous denticles.

General color ferrugineous, with light yellowish pubescence, becoming darker on disc of pronotum. Eyes, median carina of pronotum, portion of marginal carina of posterior process, base of tegmina, all femora, fore tibiae, base and apex of middle tibiae, base of hind tibiae, and apical portion of all tarsi fuscous. Apical limbus and inner area of tegmina smoky brown; veins dark brown. Marginal carinae of spatulate portion of posterior pronotal process, except at tips, conspicuously pale lemon yellow.

Length, apex of head to tips of tegmina, ♀: 8.70 mm.; width across humeral angles, ♀: 3.11 mm.

Holotype ♀: Peñón Collao, Salinas, P. R.; 3 August 1953; at light; J. A. Ramos.

Brachytalis Metcalf and Bruner

1925. *Brachytalis* Metcalf and Bruner, *Bul. Brooklyn Ent. Soc.* **20:** 204.

These are very small cuneiform insects with low shining pronotum with the posterior process symmetrically acuminate into a fine point. The tegmina are free and coriaceous for a considerable portion of the surface.

Head, across eyes, decidely narrower than prothorax across humerals, moderately protruding in front of pronotum; face subrectangular, much shorter than wide; ocelli rather inconspicuous; lower margins of genae prolonged into prominent ledges; clypeus much reduced, broad and short, moderately deflexed, slightly produced below lower margin of genae. Pronotum broad, low, moderately smooth and shining, puncturation and median carina ill-defined; sides produced into prominent postocular lobes; humeral angles prominent but short and obtuse; metopidium gently sloping, much broader than high; posterior process nearly straight in lateral view, rounded above, moderately elongate, reaching only to inner angle of tegmina; sides straight, narrowing to an acute apex. Tegmina coriaceous and punctate on basal portion; terminal portion more membranous, with venation rather weak but clearly distinguishable; five apical cells; one discoidal cell; apical limbus broad. Wings with three apical cells.

Genotype: *Brachytalis fuscus* Metcalf and Bruner (**1925:** 204–5). described from Cuba.

Brachytalis punctulatus sp. n. (fig. 14, A to E)

Very closely related to *B. fuscoalis* Metcalf and Bruner but with the pronotum and part of the tegmina dotted with fine punctules and differently colored. The male is black with yellowish markings on the pronotum, with ferrugineous and hyaline tegmina. The female is of a uniform testaceous color.

Head well exposed in front of pronotum; face convex, about two-thirds as long as wide, upper margin very slightly sinuate at middle; ocular margins vertical; lower margin of genae slightly curved, ocelli inconspicuous, closer to eyes than to each other and well above a line across center of eyes; clypeus very small. Pronotum low, moderately convex on metopidium; surface with fine punctules, which in males are more discernible along sides; anterior margins broadly and symmetrically convex; postocular lobes

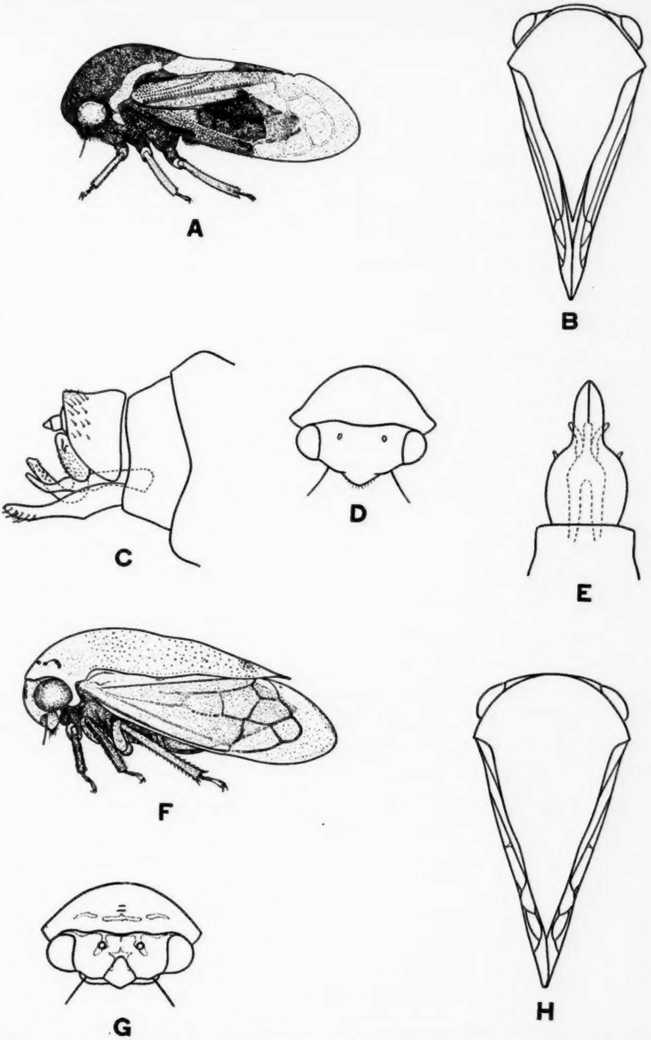

FIG. 14.—A, *Brachytalis punctulatus* sp. n., lateral view. B, *B. punctulatus* sp. n., dorsal outline. C, *B. punctulatus* sp. n., lateral view of male genitalia. D, *B. punctulatus* sp. n., frontal view. E, *B. punctulatus* sp. n., ventral view of male genitalia. F, *Micrutalis calva* (Say), lateral view. G, *M. calva* (Say), frontal view. H, *M. calva* (Say), dorsal outline.

prominent, auriculate, deflexed outward and backward, apex bluntly pointed; humeral angles moderately sharp. Tegmina coriaceous on basal two-thirds, punctate along costal cell, radial and ulnar veins, and on calvus; female tegmina with coriaceous area much more reduced but with identical puncturation; terminal third membranous, with venation more clearly defined than in opaque surface. Entire undersurface moderately pilose. Legs sparsely hairy.

Male pygofer about as long as broad, dorsal margin in profile very slightly sinuate, sides weakly narrowing ventrad; sternal plate in profile elongate, narrow, attenuated on terminal half, apex obtuse, ventral margin, angularly emarginate near middle, curving up near apex, dorsal margin broadly sinuate toward apex; in ventral aspect roughly pyriform, nearly twice as long as wide at base, apex obtusely pointed, with a median incision reaching to about two-thirds from base; lateral valves comparatively reduced, oval in outline, with a short tooth directed ventrad on upper region; styles elongate, narrowed and curved up distally, apex blunt; aedeagus U-shaped, anterior arm subequal to posterior arm, posterior arm slightly thinner, dentate on terminal half, apex almost truncate, orifice subterminal, nearly circular.

General color of male piceous. Eyes flesh colored. Postocular lobes, lateral margins of pronotum and central portion of posterior process light yellow. Basal two-thirds of tegmen ferrugineous; fuscous on costal margin, above discoidal cell and along commissural margin of clavus; terminal third yellow hyaline. Legs testaceous; femora dark fuscous. Female testaceous, lighter on dorsum of pronotum. Head with irregular spots of ferrugineous or dark fuscous; eyes rufous. Tegmina yellow hyaline with darker markings. Ventral parts of thorax fusco-piceous. Wings, in both sexes, transparent with brownish-black veins.

Length, apex of head to tip of tegmina, ♂: 2.89 mm.; ♀: 3.11 mm.; width across humerals, ♂: 1.33 mm.; ♀: 1.49 mm.

Holotype ♂: Maricao State Forest, P. R.; 27 November 1952; J. A. Ramos.

Allotype ♀: Same data.

Paratypes: 1 ♂ and 4 ♀ ♀: Same data.

Subfamily Smiliinae

The members of this subfamily are characterized by having the third apical cell of the tegmina petiolate, its base never sessile and truncate. The tegmina are always wholly membranous or with only the base and the costal area very narrowly coriaceous and punctate. The venation of the tegmina is often quite reduced and obscured.

Micrutalis Fowler

1895. *Micrutalis* Fowler, *Biologia Centrali-Americana.* **2:** 116.

These are small, stout insects with cuneiform bodies and very low, entirely naked pronotum with the posterior process symmetrically tapering to a sharp point. The tegmina are entirely free, with indistinct venation; four apical cells and no discoidal cells.

Head nearly as wide as pronotum; face rectangular, superior margin very slightly sinuate; ocular margins nearly vertical; inferior border of genae rounded; ocelli inconspicuous; clypeus moderately small, projecting for a short distance below lower border of genae. Pronotum very low, convexly flattened, cuneate in dorsal view, entirely without processes, ecarinate; metopidium sloping, wider than high; humeral angles rounded, weak, posterior process gradually acute, not quite reaching apex of abdomen. Tegmina wholly free; hyaline or semiopaque; venation obscured; four apical cells; no discoidal cells; apical limbus broad. Wings with three apical cells, second with base truncate.

Genotype: *Tragopa ephippium* Burmeister (**1836:** 191).

Micrutalis calva (Say) (fig. 14, F to H)

1830. *Membracis calva* Say, *J. Acad. Nat. Sci. Phila.* **5:** 242.

This North American species, which has been reported from other islands of the West Indies, is very variable in form and coloration.

The single female specimen at hand, collected by the writer at Doña Juana Forest, P. R., 3 November 1952, seems to agree in coloration with Cuban material referred to this species by Metcalf and Bruner (1925: 204). For this reason it seems advisable to assign it to this species until additional specimens are secured for a more detailed study.

The specimen at hand is pale yellow in color. The base of the pronotum and the face are feebly suffused with light ochraceous and marked with black, transverse lines; the entire pronotum and the legs are dotted with black. The tegmina are hyaline with the veins indicated by fuscous-black markings.

Subfamily Centrotinae

These are small, usually not abundant membracids in which the scutellum is always evident, usually only partially when the pronotum is prolonged into a posterior process or, less frequently, completely exposed when the posterior pronotal process is absent. This is the largest and most widely distributed subfamily being represented in the New and the Old World by a large number of genera and species.

Deiroderes gen. n.

This is a genus of small, delicate insects. It seems to be related to *Lophyraspis* Stal and *Tolania* Stal. It differs from the former in having the head roughly oval in outline instead of triangular and in having the ocelli closer to a line along the center of the eyes. It can be distinguished from the second of the above genera by the venation of the tegmina, principally by the possession of five apical cells instead of seven.

Head, in dorsal view, almost completely concealed by pronotum; face wider than long, slightly convex; base sulcate at middle; lower margins of genae strongly produced; ocelli closer to eyes than to each other, clypeus with terminal half lobe-like, projecting downward and backward from ventral border of face. Pronotum, in profile, well elevated, hood-like; moderately crested on median line or with a prominent median carina, base sharply bent horizontally, margin forming a prominent ledge above head; metopidium vertical, less so at sides and behind eyes; humeral angles short, not prominent; region above them simple or raised into a short, low ridge; posterior margin squarely produced distad; scutellum prominent, fully exposed. Tegmina opaque and strongly punctate, at least on basal third; venation rather weak; five apical cells, third longest, last largest; one anteapical cell. Wings with four apical cells.

Genotype: *Deiroderes inermis* sp. n.

Deiroderes inermis sp. n. (fig. 15, A to E).

This species closely resembles *Tolania punctata* Metcalf and Bruner, described from Cuba, which is hereby assigned to the genus *Deiroderes* gen n., but differs in being smaller, in having a less elevated pronotum without a dorsal crest and suprahumeral ridges, and in having the tegmina punctate on the basal two-thirds.

Face decidedly convex, broad, moderately long; entire surface rugose; base with a small but prominent sulcus at middle; lower margins of genae sinuous, carinate; clypeus prominent, strongly deflexed. Pronotum gibbous; base bent forward above base of head; without a dorsal crest but with a strong median carina; no suprahumeral ridges; humeral angles short and blunt; posterior margins squarely emarginate, carinate; entire surface heavily punctate. Scutellum with basal half tumid, terminal half flattened; entire surface punctate. Tegmina as in *D. punctatus* (Metcalf and Bruner) but punctate to level of apex of commissural margin. Sides and ventral parts of thorax rugose. Legs with femora rugose; tibiae with heavy, short pile and a double row of peg-like spines; metatibiae slightly curved.

Pygofer of male gibbous dorsally, sides gradually narrowing; lateral valves prominent, oblique, elongate, all margins nearly straight, posterior upper angle prolonged into a prominent, blunt process; sternal plate elon-

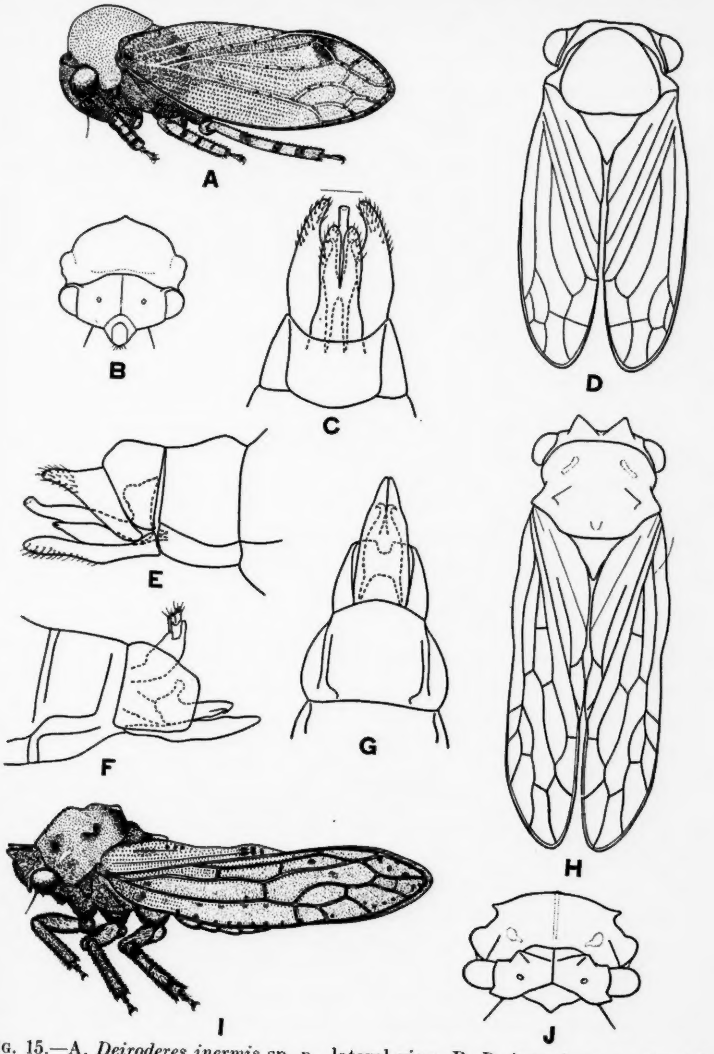

FIG. 15.—A, *Deiroderes inermis* sp. n., lateral view. B, *D. inermis* sp. n., frontal view. C, *D. inermis* sp. n., ventral view of male genitalia. D, *D. inermis* sp. n., dorsal outline. E, *D. inermis* sp. n., lateral view of male genitalia. F, *Antillotolania doramariae* sp. n., lateral view of male genitalia. G, *A. doramariae* sp. n., ventral view of male genitalia. H, *A. doramariae* sp. n., dorsal outline. I, *A. doramariae* sp. n., lateral view. J, *A. doramariae* sp. n., frontal view.

gate and narrow in profile, dorsal margin shallowly concave, ventral margin broadly angled near middle, apex bluntly rounded; in ventral view, a little over twice as long as wide, lateral margins sinuate, terminal half divided by a median incision into two long, narrow, apically rounded lobes; styles elongate, tapering to a fine point which curves outward into a short hook; aedeagus comparatively large in size, anterior arm much shorter, stout, posterior arm elongate, tubular, terminal portion slightly upcurved.

General color yellowish brown, darker on face, sides and ventral parts of thorax and femora. Terminal three-fourths of tegmina milky translucent; veins whitish, dots on veins dark yellowish brown, a large brownish yellow spot on corium below apex of commissure. Wings transparent; veins yellowish brown. Tibiae pale stramineous with darker spots; tarsi pale stramineous.

Length, front of head to apex of tegmina, ♂: 3.48 mm., ♀ : 3.51 mm.; width across humerals, ♂: 1.30 mm., ♀ : 1.31 mm.

Holotype ♀ : Guánica State Forest, P. R.; 3 August 1945; on *Capparis indica* (L.) Fawc. and Rendle; J. A. Ramos.

Allotype ♂: Same locality; 19 November 1947; J. A. Ramos.

Paratype: 1 ♀ : Cambalache Experimental Forest, P. R.; 7 November 1947; J. S. Caldwell and L. F. Martorell.

Antillotolania gen. n.

This genus seems to be related to *Tolania* Stal but the head is wider, differently shaped and bicornute at the base. The clypeus is not trilobed and is very strongly deflected backward. The metopidium is decumbent and the scutellum ecarinate. The tegmina possess five or six apical cells and three discoidal cells.

Head wider than pronotum; base sulcate at middle, strongly bicornute; face rectangular, much wider than long, ocular margins nearly straight; lower margin of genae deflexed with outer angles produced, prominent; ocelli very prominent; clypeus large, extending below inferior margin of genae, deflexed to nearly a horizontal position; eyes very prominent, salient. Pronotum rather low; metopidium decumbent, wider than high; base with strong depressions; humeral angles short, broad; suprahumerals produced into dorsolateral horns; median carina well defined; with a small tubercle just caudad of suprahumerals. Scutellum fully exposed; swollen except at tip; ecarinate. Tegmina semiopaque, coriaceous, punctate and pubescent at base; veins indistinct on basal half; six apical cells in male, five in female; three discoidal cells; apical limbus obsolescent. Wings with four apical cells.

Genotype: *Antilletolania doramariae* sp. n.

Antillotolania doramariae sp. n. (Fig. 15, F to J).

This is a slender, elongate, punctate, pilose species of a fuscous color with the tegmina heavily marked with darker spots and irregular blotches. The head is strongly bicornute at the base and the pronotum possesses two suprahumeral horns which are very variable in prominence and sharpness.

Head short and wide; face punctate, tomentose, about twice as wide as long; upper margin curved; ocelli closer to eyes than to each other and lying about on a line connecting center of eyes; clypeus flat, about as long as wide; eyes curved backward, ovoid. Pronotum strongly punctate, tomentose; humerals moderate, blunt. Scutellum triangular, scarcely as long as wide, punctate, tomentose; tip acute. Tegmina with median discoidal cell longest; first apical cell fusiform, second short and narrow, third and fourth large. Sides and ventral parts of thorax tomentose. Legs with tibiae narrowly flattened, pilose. Venter with very sparse hairs.

General color yellowish fuscous, darker on dorsum of pronotum, suprahumerals, scutellum and sides of thorax. Tegmina strongly marked with reddish brown. Wings yellow hyaline; veins reddish brown. Legs with dark ferrugineous markings. Venter testaceous.

Length, tip of frontal horns to apex of tegmina, ♂: 5.33 mm., ♀ : 5.85 mm.; width across humeral angles, ♂ : 1.52 mm.; ♀ : 1.55 mm.

Holotype ♂: Maricao State Forest, P. R.; 27 November 1952; J. A. Ramos.

Allotype ♀ : Carite State Forest, P. R.; 2 October 1947; J. S. Caldwell and L. F. Martorell.

Brachycentrotus Metcalf and Bruner

1926. *Brachycentrotus* Metcalf and Bruner, *Bul. Brooklyn Ent. Soc.* **21:** 28.

These are very small insects with short, cuneiform bodies. The pronotum is strongly punctate with the posterior process broad, reaching only to the apex of the clavus. The basal half of the tegmina is conspicuously coriaceous and strongly punctate, the apical half is transparent with prominent veins.

Head almost concealed from above by pronotum; face very broad; ocelli wide apart from each other, closer to basal margin than to eyes. Pronotum well elevated, strongly and uniformly punctate; median carina obsolescent; metopidium very steep; anterior lateral borders produced downward into narrow postocular lobes; humeral angles moderately produced; posterior process broad, nearly flat, narrowing to a sharp point, reaching apex of clavus. Scutellum rather poorly exposed. Tegmina with basal half coriaceous and strongly punctate except for a narrow band along claval suture; veins on this area obscured; five apical cells; three discoidal cells, first two smaller and similar, inner longest; apical limbus broad. Wings with four apical cells.

Genotype: *Brachycentrotus punctatus* Metcalf and Bruner (**1925:** 212-3), a Cuban species.

Brachycentrotus rufinervis sp. n. (Fig. 16, A to E).

This species differs from *B. punctatus* Metcalf and Bruner in being smaller and more depressed, and from *B. hirsutus* Metcalf and Bruner in not being hirsute and in coloration.

Head distinctly narrower than pronotum; face strongly incurved in lateral view, entire surface rugose; base slightly curved, with margin raised, lower borders of genae well produced; clypeus wider than long, forming a short lobe on lower margin of face. Pronotum in profile, smoothly convex on metopidium, nearly straight caudad; in dorsal view, with front margin strongly curved; metopidium shallowly sunken above eyes; posterior process somewhat constricted near middle, then narrowing to an acute point; entire surface with large, deep punctures. Scutellum well exposed, opposite constriction of posterior pronotal process. Tegmina typical; punctures on basal half large and very strong. Entire ventral surface covered with appressed hairs.

Male pygofer in lateral aspect long and broad, posterior margin strongly sinuous; lateral valves comparatively small, oblique, oval in outline; sternal plate, in profile, long and narrow, dorsal margin concave, ventral margin curved, with a wide lobe near base, apex obtusely pointed; in ventral aspect, twice as long as wide, lateral margins subparallel, apex broadly rounded with a moderately shallow median incision; styles elongate, wider at base, tapering to a blunt point turned slightly outward and upward; aedeagus with anterior arm shorter and stouter than posterior arm, posterior arm ending in an attenuated point and bearing a row of small peglike teeth on each side near anterior margin.

Head, a wide band on metopidium and whole ventral surface piceous. Pile on undersurface yellowish white. Eyes and ocelli pale whitish yellow. Pronotum stramineous; punctures light ferrugineous. Basal half of tegmina reddish brown to yellowish at middle, punctures fuscous; terminal half clear with a brown fascia crossing apical cells and on base; veins rufous. Wings transparent; veins light brown. Legs with coxae, trochanters and femora except apex piceous; tip of femora and tibiae ferrugineous; tarsi brownish yellow; denticles on metatibiae piceous.

Length, apex of head to apex of tegmina, ♂: 2.50 mm.; ♀ : 2.70 mm.;
width across humeral angles, ♂: 1.30 mm., ♀ : 1.44 mm.

Holotype ♂: Maricao State Forest, P. R.; 27 November 1952; on
Dipholis Sintenisiana Pierre; J. A. Ramos.

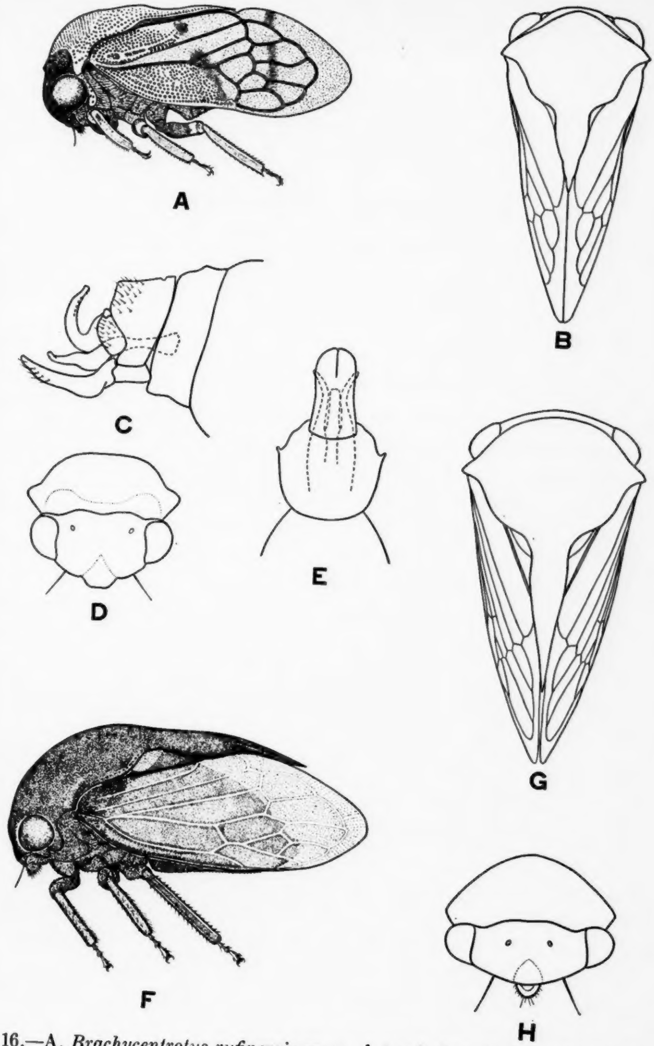

FIG. 16.—A, *Brachycentrotus rufinervis* sp. n., lateral view. B, *B. rufinervis* sp. n., dorsal outline. C, *B. rufinervis* sp. n., lateral view of male genitalia. D, *B. rufinervis* sp. n., frontal view. E, *B. rufinervis* sp. n., ventral view of male genitalia. F, *Monobelus fasciatus* (Fabricius), lateral view. G, *M. fasciatus* (Fabricius), dorsal outline. H, *M. fasciatus* (Fabricius), frontal view.

Allotype ♀: Same data.

Paratypes: 1 ♂: same locality; 5 November 1952; J. A. Ramos; 1 ♂: same data as type; 2 ♀♀: same locality; 5 November 1952; J. A. Ramos; 3 ♀♀: same data as type. All these specimens were also collected on *Dipholis Sintenisiana* Pierre.

Monobelus Stal

1866. *Monobelus* Stal, *Berliner Ent. Zeit.* **10:** 386.

Small or medium size insects in which the pronotum does not project in front of the head but is extended backward into a slender, elongate process; the humeral angles are short and not developed into horns or spines. The body is robust and cuneiform in dorsal aspect.

Head, across eyes, nearly as wide as pronotum; very short and broad; anterior margin gently arched; face wider than long, base arcuate; lower margins of genae projected downward, forming deep antennal cavities; ocelli prominent, equidistant from each other and from eyes; eyes large, globular; clypeus produced below ventral margins of genae, tip rounded. Pronotum broad, convex, feebly punctate; metopidium sloping, much broader than high; base broadly rounded; sides prolonged downward into prominent postocular lobes; humeral angles short, broad, blunt; posterior process long, attenuated into a sharp point, extending to tip of abdomen. Scutellum well exposed on each side. Tegmina completely free, hyaline; base coriaceous and punctate; veins conspicuous; corium with five apical cells and one or two discoidal cells; apical limbus moderately broad.

Genotype: *Membracis fasciata* Fabricius (**1798:** 515) was described from the West Indies

Monobelus fasciatus (Fabricius) (Figs. 16, F to H and 17, A and B).

1798. *Membracis fasciata* Fabricius, *Suppl. Ent. Syst.* **1798:** 515.

1935. *Monobelus fasciatus* Osborn, *Sci. Surv. Porto Rico and Virgin Islands* **14:** 122–4.

1936. *Monobelus fasciatus* Wolcott, *J. Agr. Univ. P. R.* **20:** 74.

1950. *Monobelus fasciatus* Wolcott, *J. Agr. Univ. P. R.* **32:** 104–6.

1951. *Monobelus fasciatus* Funkhouser, *Gen. Insect. Homoptera. Membracidae. Fasc.* **208:** 192.

A small robust species of an intense black or dark ferrugineous color and yellowish hyaline tegmina.

Face slightly convex, nearly vertical in profile; eyes prominent. Pronotum very broad, strongly convex on metopidium, densely and uniformly covered with minute, rather inconspicuous punctures except on terminal half of posterior process; posthumeral borders with a submarginal row of deep punctures; humeral angles short and wide; posterior process tapering to an

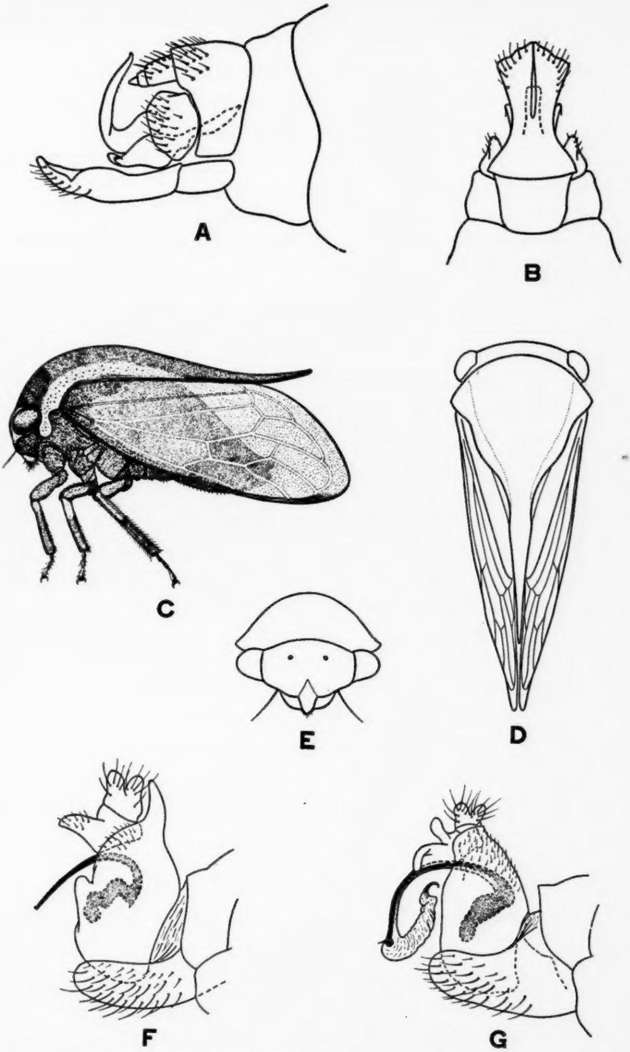

FIG. 17.—A, *Monobelus fasciatus* (Fabricius), lateral view of male genitalia. B, *M. fasciatus* (Fabricius), ventral view of male genitalia. C, *M. maldonadoi* sp. n., lateral view. D, *M. maldonadoi* sp. n., dorsal outline. E, *M. maldonadoi* sp. n., frontal view. F, *Borencona aguadilla* Davis, lateral view of male genitalia. G, *Proarna hilaris* (Germar), lateral view of male genitalia.

acute point, terminal half with two marginal and a median obsolescent carinae. Scutellum wide, plainly exposed, densely pubescent at base. Ventral parts, sides of thorax and venter covered with abundant short pile. Tegmina completely free, strongly tectiform; base narrowly coriaceous and punctate; corium hyaline; veins prominent, two discoidal cells. Wings with third apical cell a little longer than second. Legs with femora sparsely pilose; tibiae with longer, stiff hairs.

Male pygofer long and broad, dorsal margin in profile nearly straight; lateral valves comparatively small, roughly oval in outline; sternal plate, in profile, very long and narrow, ventral margin smoothly concave, dorsal margin sinuous, apex narrowed to a blunt point, slightly curved upward; in ventral aspect nearly twice as long as wide, base wider than apex, lateral margins strongly sinuate at middle, apex triangularly produced, a median narrow incision reaching forward to about middle; styles comparatively short, base very broad, terminal portion attenuated to an acute apex which is curved outward and then forward; aedeagus with anterior arm shorter and stouter than posterior arm, posterior arm attenuated and with minute teeth on anterior surface.

General color dark ferrugineous to piceous. Eyes reddish, Pronotum sometimes with a faint narrow stripe of yellowish on lateral margins. Hairs on sides and ventral parts of thorax and on venter grayish white. Tegmina yellow hyaline, base black; veins yellowish brown, darker on disc and on costal area. Wings transparent; veins light brown. Legs dark castaneous.

Length, apex of head to tip of tegmina, ♂: 5.00 mm., ♀: 5.60 mm.; width across humeral angles, ♂: 2.40 mm., ♀: 2.80 mm.

This is a common species occurring all over the island. Numerous specimens are at hand from different localities along the coast and in the interior of the island. According to Wolcott (1950: 104) the species occurs on a great variety of plants, showing no apparent host preference. The species is also distributed in some of the other West Indian islands.

Monobelus maldonadoi sp. n. (Fig. 17, C to E).

This species resembles *M. fasciatus* (Fabricius) but it is more elongate and slender. It may be easily identified by the conspicuous yellowish band at the sides of the pronotum and by the possession of one anteapical cell on the tegmina instead of two, as is the case of the other species of the genus.

Face nearly flat, almost vertical in profile. Pronotum, in lateral view, with dorsal margin evenly convex on metopidium but nearly straight on posterior process; humeral angles very short and obtuse; posterior process elongate, tapering to a sharp point, completely ecarinate; entire surface nearly smooth, except along sides where there are numerous obsolescent punctures. Scutellum exposed but comparatively less than in *M. fasciatus* (Fabricius).

Ventral parts and sides of thorax and entire venter covered with rather dense pile. Tegmina completely free, steeply tectiform, hyaline; base and greater portion of costal cell coriaceous and feebly punctate; veins rather weak; corium with a single discoidal cell instead of two. Wings with third apical cell much longer than second. Legs with femora sparsely haired; tibiae with numerous stiff hairs only on hind surface.

Head pitch-black; eyes, ocular margins of face, lower outer angles of genae, and ocelli brownish yellow. Pronotum black with a conspicuous yellowish band on sides from eyes to base of posterior process, preceded by a narrow reddish brown area which is more evident caudad. Entire undersurface and abdomen fusco-piceous, pubescence grayish white. Tegmina yellow hyaline, base and costal area fuscous; veins brownish yellow. Wings clear hyaline; veins dark brown, lighter at base. Legs pale fuscous, darker on femora; middle and hind tibiae conspicuously yellow at base.

Length, apex of head to tip of tegmina, ♂: 6.60 mm.; width across humeral angles, ♀ : 2.60 mm.

Holotype ♀ : Cerro Maravillas, Villalba, P. R.; 2 March 1946; J. Maldonado Capriles.

Paratypes: 1 ♀ : same data as type; 1 ♀ : Matrullas, P. R.; 21 February 1932; S. T. Danforth.

This species is named after my friend and colleague, Dr. J. Maldonado Capriles, who has contributed much to the knowledge of the Puerto Rican insect fauna.

Monobelus nasutus Stal and *M. obtusiceps* Stal are credited to Puerto Rico by Funkhouser (1951: 192). Since the author has not seen any specimens that answer the descriptions of these two species, in spite of the extensive series of specimens of this genus examined by him, he does not consider that these records are valid and, therefore, deletes them from the Puerto Rican fauna.

FAMILY CICADIDAE

The members of this family are generally large insects. The body is subconical and prominent; the head is short and wide with the large eyes on the outer angles; the wings are large and membranous. The ocelli are three in number and are placed near together forming a small triangle on the disc of the crown. The males possess peculiar stridulatory organs located at the base of the abdomen on the ventral side, by means of which they emit a characteristic shrill cry that explains the vernacular name of "chicharras" in Puerto Rico. The females generally insert their eggs into the twigs and branches of trees and other plants by means of their ovipositors; the nymphs live underground feeding on the roots.

Key to the Genera and Species of Puerto Rican Cicadidae

1. Head very narrow; sides of pronotum greatly expanded outward; first cross vein of the tegmina slanting toward the body; tegmina semiopaque .... *Borencona aguadilla* Davis
1. Head broader; sides of pronotum not expanded laterally; first cross vein of tegmina slightly curved; tegmina hyaline *Proarna hilaris* (Germar)

Borencona Davis

1928. *Borencona* Davis, *J. N. Y. Ent. Soc.* **36:** 31.

A monotypic and autochthonous genus related in most respects to *Odopoea* Stal but with the first cross vein of the tegmina slanting toward the body instead of outwardly. It differs from *Zammara* Amyot and Serville in having the upper or Cu_1 vein of the eighth marginal cell of the tegmina curved instead of greatly arched.

Body short and robust, broader below tympana in male. Head very short and narrow, considerably narrower than pronotum; rostrum reaching posterior coxae. Pronotum very broad; sides prominently expanded outward, margins medially angulate. Tympanal coverings imperfect, concealing only extreme outer parts of orifices; opercula short, broad and rounded. Tegmina nearly opaque; first cross vein slanting toward body; upper or Cu_1 vein of eighth marginal cell curved, not greatly arched.

Genotype: *Borencona aguadilla* Davis (**1928:** 31).

Borencona aguadilla Davis (Fig. 17, F).

1923. *Zammara sp.* Wolcott, *J. Dept. Agr. P. R.* **7:** 256.
1928. *Borencona aguadilla* Davis, *J. N. Y. Ent. Soc.* **36:** 31–3.

A rather small species readily recognized by the lateral expansions of the pronotum, brownish green general color, and semiopaque tegmina and wings.

Head, including eyes, narrow, about half as broad as pronotum; crown with three small lobes on anterior margin. Pronotum with posterior angles produced. Tegmina rounded at apex; anterior and posterior margins considerably curved; transverse fold plainly developed; basal cell long, with front and hind margins almost parallel; first cross vein starting from basal fourth of first marginal cell and running toward body. Tympana much exposed, specially on outer part. Opercula short and rounded, not reaching third abdominal sternite. Abdomen broadest below tympanal orifices.

Male pygofer, in lateral view, much longer than wide, with a large spine-like process dorsally and a smaller, lobate one on posterior margin; sternal plate broad and long, broadly rounded apically; aedeagus consisting of a strongly chitinized, slender, sickle-shaped structure.

General color brownish green about tympana and margins of pronotum, with a narrow and irregular brownish dorsal stripe extending from center of head to hind margin of pronotum; this stripe widening irregularly on mesonotum. Abdomen, in both sexes, with two pruinose curved lines above; each abdominal segment narrowly edged with greenish; in female, last two segments dorsally pruinose. Venter pallid. Tegmina and hind wings with veins flecked with fuscous; spots arranged in pairs on costal margin of tegmina; central portion of all cells, especially of fore wings, likewise marked with brown.

Length of body, ♂: 22 mm.; ♀: 21 mm.; expanse of wings, ♂: 56 mm.; ♀: 61 mm.

This is a rather common species. Although there are several records of its capture at Mayagüez and Río Piedras, the species is more abundant in the humid higher forests of the interior, especially in the western two-thirds of the island. According to the numerous specimens at hand, the adults seem to be most common from July to November.

Proarna Stal

1864. *Proarna* Stal, *Ann. Soc. Ent. France* **4:** (4) 61.

This is a genus of rather small species. It may be readily recognized by the transverse vein at the base of the second apical cell of the tegmina which is more or less vertical. The sides of the pronotum are not expanded as in *Borencona* Davis.

Head, across eyes, about equal in width to base of pronotum; eyes scarcely projecting beyond anterior angles of pronotum; vertex, at area of ocelli, distinctly longer than front. Pronotum a little shorter than mesonotum; posterior angles a little prominent but not lobately produced. Metasternum with a moderately elevated transverse central plate which is not angularly produced anteriorly. Tegmina with eight apical cells; basal cell longer than broad; cross vein at base of second apical cell more or less vertical; wings about half as long as tegmina. Abdomen about as long as space between apex of head and base of cruciform elevation.

Genotype: *Cicada hilaris* Germar (**1844:** 69).

Proarna hilaris (Germar) (Fig. 17, G).

1834. *Cicada hilaris* Germar, *Rev. Ent. Silbermann.* **2:** 69.

A small grayish-brown species with the wings sparsely maculate or completely clear.

Head, including eyes, a little over three-fourths as broad as pronotum; crown trilobate on anterior margin, median lobe much larger and prominent. Pronotum about two and one-half times as broad as long; posterior angles somewhat prominent but not produced. Tegmina moderately rounded at apex; anterior and posterior margins moderately curved; basal cell elongate; first cross vein arising at middle of first apical area, slightly incurved.

Male pygofer, in lateral aspect, much longer than broad, roughly conical in shape; sternal plate long and broad, broader at base; aedeagus very large and prominent, proximal portion tubular, strongly chitinized and curved downward, terminal portion membranous, bladderlike, this structure bearing a minute, stiff spine at base on left side and a hooked chitinized apical spine.

General color grayish brown with darker markings above; eyes reddish brown; basal half of costae contrastingly cream colored; wings very sparsely maculate or completely clear.

Length of body, ♂: 16 mm., ♀: 18 mm.; expanse of wings, ♂: 48 mm. ♀: 50 mm.

This is the common cicada of Puerto Rico. It occurs all over the island, from the dry, xerophytic districts on the coast to the humid forests of the interior, as it is evident from the extensive collection at hand. The adults are found during all the months of the year but they seem to be more abundant from May to November. Wolcott (1950: 103) reports finding the nymphs apparently feeding on the roots of *Wedelia trilobata* (L.) Hitchcock.

DISCUSSION

The taxonomic account of the families Kinnaridae, Cercopidae, Membracidae, and Cicadidae presented in this work completes the review of the auchenorhynchous Homoptera of Puerto Rico. This study was initiated in 1950 by Caldwell and Martorell, who published a similar treatise on the Cicadellidae (1950a) and on the Fulgoroidea exclusive of the Kinnaridae (1950b). The completion of this work reveals a total of 317 forms of Auchenorhyncha known to occur in Puerto Rico. Of this number, 147 are new to science and 30 constitute new records. The families included in this report are represented by 37 species, 22 of which are described as new and 4 are given as new records (see table 1.) Six previous records of various authors, namely *Epicranion championi* Fowler, *Philaenus fuscovarius* Stal, and *Clastoptera brevis* (Walker) in the Cercopidae; and *Nessorhinus vulpes* Amyot and Serville, *Monobelus nasutus* Stal and *M. obtusiceps* Stal in the Membracidae, are not recognized because of misidentifications or synonymy.

In the following sections each of the four families included in this report is separately discussed and analyzed.

FAMILY KINNARIDAE

A total of 12 species belonging to this family are reported from Puerto Rico in the present account. These are all endemic. They are grouped into

TABLE 1.—*An analysis by families of the genera and species included in this revision*

Family	Previously known from the region (Wolcott 1950)		Reported in this paper		New to science		New records	
	Genera	Species	Genera	Species	Genera	Species	Genera	Species
Kinnaridae	1	4	2	12	1	8	0	0
Cercopidae	3	3	5	8	2	5	2	2
Membracidae	3	5	12	15	4	9	5	2
Cicadidae	2	2	2	2	0	0	0	0
Total	9	14	21	37	7	22	7	4

two genera one of which, *Oreopenes* gen. n., is monotypic and endemic and the other, *Quilessa* Fennah, is shared with the Lesser Antilles.

As compared to the other Antilles, Puerto Rico thus shows a rich kinnarid fauna. Cuba has only five species that fall into three genera, two of which are endemic. Jamaica claims two species only which belong to a widely distributed genus. Hispaniola possesses the same number of species and genera as Cuba, all of them endemic. The Lesser Antilles have all together 14 forms grouped into two genera, one of which is endemic (see table 2). A possible explanation accounting for the richer kinnarid fauna of Puerto Rico might be the fact that the island has been more intensively collected than any of the other Greater Antilles.

FAMILY CERCOPIDAE

The Cercopidae are very poorly represented in the Puerto Rican fauna, only 8 species being reported herein from this region. Of this number, 5 species are described as new to science and 2 constitute new records for the island (see table 1). This is really a very limited number of forms for the island as compared to the 23 species known from Cuba, as reported by Metcalf and Bruner (1944).

The eight Puerto Rican species fall into five genera, two of which are monotypic and endemic (*Asprocranites* gen. n. and *Gaetopsis* gen. n.); one is shared with Cuba only (*Leocomiopsis* Metcalf and Bruner); one is strictly Greater Antillean in distribution with representatives in each of these four island (*Leocomia* Ball) and one is widely distributed throughout North, Central and South America (*Clastoptera* Germar) (see table 2). This evidence shows that the Puerto Rican cercopid fauna, although very poor in number of forms, is essentially endemic and Greater Antillean in character, with very little continental affinity and with none with the Lesser Antilles.

A striking characteristic of this fauna is the interesting fact of the ab-

TABLE 2.—*A zoogeographical analysis of the Kinnaridae, Cercopidae, Membracidae, and Cicadidae of Puerto Rico*

Family and genera	Number of species	Endemic to Puerto Rico	Greater Antilles	Lesser Antilles	Central America	South America	North America
KINNARIDAE							
Oreopenes	1	X					
Quilessa	11			X			
CERCOPIDAE							
Leocomia	1		X				
Leocomiopsis	1		X				
Asprocranites	1	X					
Gaetopsis	1	X					
Clastoptera	4		X	X	X	X	X
MEMBRACIDAE							
Jibarita	1	X					
Bolbonota	1			X	X	X	X
Nessorhinus	3		X				
Spinodarnoides	1					X	
Paradarnoides	1			X			
Spathenotus	1	X					
Brachytalis	1		X				
Micrutalis	1		X	X	X	X	X
Deiroderes	1		X				
Antillotolania	1	X					
Brachycentrotus	1		X				
Monobelus	2		X	X			
CICADIDAE							
Borencona	1	X					
Proarna	1		X	X	X	X	X
Total	37	7	10	7	4	5	4

sence of representatives of the Tomaspidini, of which two forms are known from Cuba and others from Jamaica and other of the West Indies.

FAMILY MEMBRACIDAE

In the present account, a total of 15 species belonging to this family is recorded from Puerto Rico. This seems to be a fairly large number of forms for the island, considering that Cuba, which is much larger and with a richer flora and fauna, claims 21 forms (Metcalf and Bruner, 1925). Of these 15 forms, 9 are described herein as new to science and 2 are reported as new records (see table 1).

These 15 species represent 12 different genera, 3 of which are endemic (*Jibarita* gen. n., *Spathenotus* gen. n. and *Antillotolania* gen. n.); 3 are shared with Cuba only (*Brachytalis* Metcalf and Bruner, *Deiroderes* gen. n.

and *Brachycentrotus* Metcalf and Bruner) 1 is common with the Lesser Antilles only (*Paradarnoides* Fowler); 1 is widely distributed in the West Indies (*Monobelus* Stal); 1 is shared with Cuba and Hispaniola (*Nessorhinus* Amyot and Serville); 1 is also known from British Guiana (*Spinodarnoides* Funkhouser) and the rest are widely distributed in the Americas (*Bolbonota* Amyot and Serville and *Micrutalis* Fowler) (see table 2). This analysis shows greater affinities of the Puerto Rican membracid fauna to that of the other Greater Antilles.

An interesting peculiarity of this fauna, as compared to that of Cuba, is the presence of representatives of the Membracinae, which are absent from that island, and the absence of members of the Hoplophorioninae, which, on the other hand, occur in Cuba.

FAMILY CICADIDAE

Of the four families covered in this report, the Cicadidae show the most extreme paucity of forms. Only two species of cicadas are definitely recorded from Puerto Rico, in spite of the statement given by Davis (1928: 29) to the effect that there should be no doubt that several others are to be found and that ultimately this number would be doubled.

The common cicada of Puerto Rico, *Proarna hilaris* (Germar), is a widely distributed species in the West Indies and has also been reported from Central America. The second species, *Borencona aguadilla* Davis, represents a monotypic genus endemic to the Island. This is a most unusual and unique form due to the fact that the first cross vein of the tegmina slants toward the body instead of away from it, as is usual among all members of the family. The species is primarily a form peculiar to the mountains of the interior of the island.

SUMMARY

This work presents a taxonomic study of the Kinnaridae, Cercopidae, Membracidae and Cicadidae of Puerto Rico. With it, the entire revision of the Auchenorhyncha of the island, as initiated by Caldwell and Martorell in 1950, with a similar treatment of the Cicadellidae and of the Fulgoroidea except the Kinnaridae, is brought to conclusion.

A total of 37 species in these familes is listed from the region, with notes on their distribution, abundance and host plants. Keys are given for the identification of the species in each family.

The following new genera and species are described; *Oreopenes* gen. n., *O. luteifacies* sp. n.; *Quilessa collaris* sp. n., *Q. pellucidoides* sp. n., *Q. atrata* sp. n., *Q. nahiba* sp. n., *Q. heminfuscata* sp. n., *Q. oraria* sp. n., *Q. wirshingi* sp. n. in the Kinnaridae; *Leocomia uprae* sp. n.; *Asprocranites* gen. n., *A. variegata* sp. n.; *Gaetopsis* gen. n., *G. juanalis* sp. n.; *Clastoptera martorelli* sp. n. and *C. diminuata* sp. n., in the *Cercopidae*; *Jibarita* gen. n., *J. borincana* sp. n.; *Nessorhinus esbeltus* sp. n.; *Paradarnoides caldwelli* sp. n.; *Spathenotus* gen. n., *S. tridentatus* sp. n.; *Antillotolania* gen. n., *A. doramariae* sp. n.; *Brachycentrotus rufinervis* sp. n. and *Monobelus maldonadoi* sp. n. in the Membracidae.

The Puerto Rican fauna of the families Kinnaridae, Cercopidae, Membracidae, and Cicadidae is discussed and analyzed.

RESUMEN

Este es un estudio taxonómico de las Kinnaridae, Cercopidae, Membracidae y Cicadidae de Puerto Rico. Con el mismo se concluye la revisión entera de las Auchenorhyncha de la Isla, según fué iniciado por Caldwell y Martorell en el 1950, con un tratamiento similar de las Cicadelliade y las Fulgoroidea, a excepción de las Kinnaridae.

Se cataloga un total de 37 especies de estas familias de la región con observaciones sobre su distribución, abundancia y plantas hospederas. Se dan claves para la indentificación de las especies de cada familia.

Se describen los siguientes nuevos géneros y especies; *Oreopenes* gen. n., O. *luteifacies* sp. n.; *Quilessa collaris* sp. n., *Q. pellucidoides* sp. n., *Q. atrata* sp. n., *Q. nahiba* sp. n., *Q. heminfuscata* sp. n., *Q. oraria* sp. n., *Q. wirshingi* sp. n. en la Kinnaridae; *Leocomia uprae* sp. n.; *Asprocranites* gen. n., *A. variegata* sp. n.; *Gaetopsis* gen. n., *G. juanalis* sp. n.; *Clastoptera martorelli* sp. n. y *C. diminuata* sp. n., en la *Cercopidae*; *Jibaraita* gen. n., *J. borincana* sp. n.; *Nessorhinus esbeltus* sp. n.; *Paradarnoides caldwelli* sp. n.; *Spathenotus* gen. n., *S. tridentatus* sp. n.; *Antillotolania* gen. g., *A. doramariae* sp. n.; *Brachycentrotus rufinervis* sp. n. y *Monobelus maldonadoi* sp. n. en la *Membracidae*.

Se discute y analiza la fauna puertorriqueña de las familias Kinnaridae, Cercopidae, Membracidae y Cicadidae.

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[3] Leave to pursue studies.

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VOL. XLI APRIL 1957 NO. 2

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UNIVERSITY OF PUERTO RICO

1903

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PUBLISHED BY
UNIVERSITY OF PUERTO RICO
AGRICULTURAL EXPERIMENT STATION
RIO PIEDRAS, P. R.

Entered as second-class matter June 1, 1953, at the post office at Rio Piedras, under the Act of August 24, 1912, as amended by the Act of August 4, 1947.

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